Diesel Power

& Diesel Transportation

Tool

and

Maintenance

Number

Our 28th Year

DECEMBER, 1950

MORE GREATER ECONOMY

Texaco Ursa Oils reduce maintenance costs

Your engines – Diesel, gas or dual-fuel – are designed for power. *Texaco Ursa Oils* are designed to help them deliver that power. These famous oils resist oxidation, stand up under heat and pressure, and keep engines clean. Rings stay free, ports stay open, and valves function properly.

Better compression and combustion . . . smoother operation . . . minimum wear . . . all are assured with *Texaco Ursa Oils*. This means longer life for bearings and all moving parts . . . lower maintenance costs and less fuel consumption.

Texaco Ursa Oils are available in proper vis-

TUNE IN . . . TEXACO presents MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.

TEXACO

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DIESEL POWER and DIESEL TRANSPORTATION for December, 1950, Vol. XXVIII, No. 12. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices 192 Lexington Ave., New York 16, N. Y. Subscription rates: United States, $3.00 per year, single copies 35¢. Canada $4.00; Foreign, $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut, under Act of March 3, 1879.

POWER

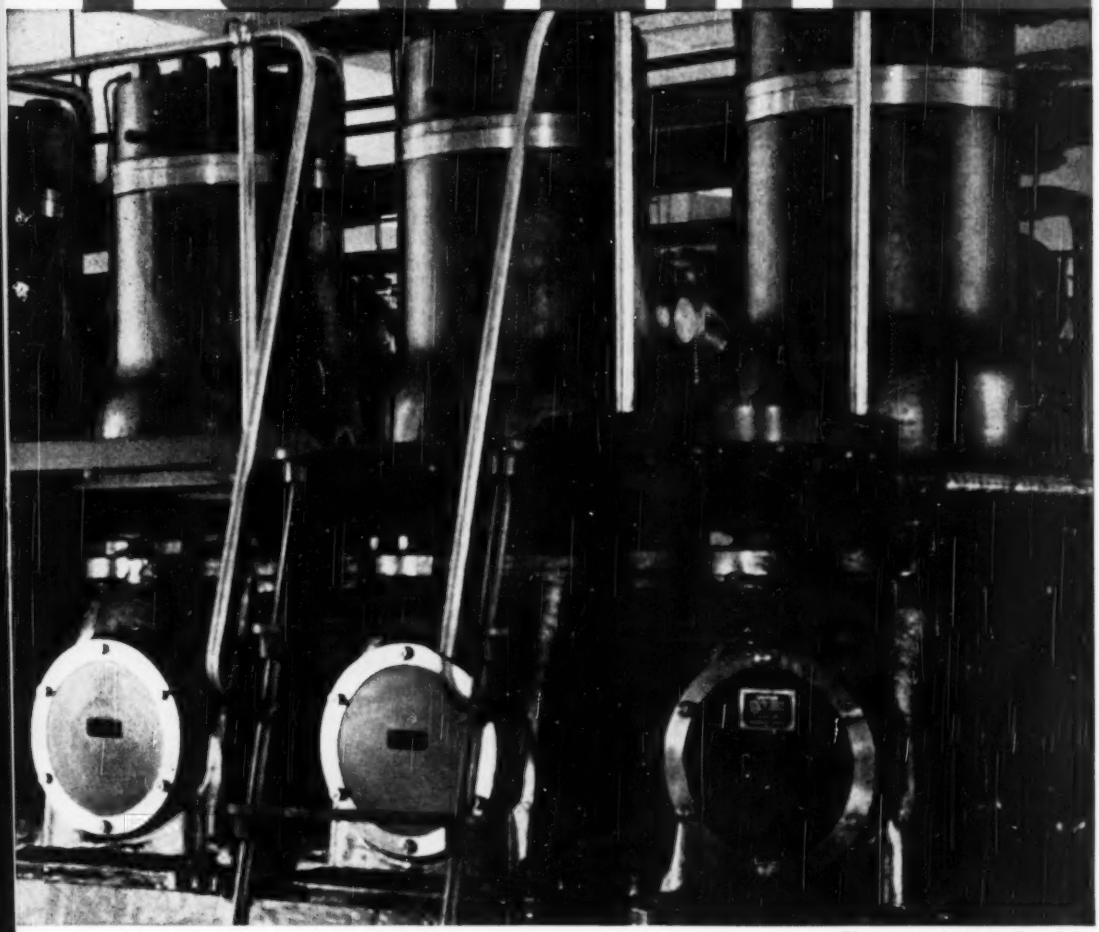


Photo courtesy Fairbanks, Morse & Co.

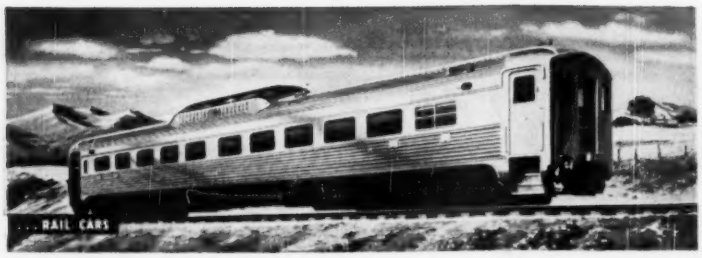
cosities for every need and are approved by leading Diesel manufacturers. They are America's favorite. For instance, in the Diesel field:

★ ★ ★

More stationary Diesel h.p. in the U.S. is lubricated with Texaco Ursa Oils than with any other brand.

Let a Texaco Lubrication Engineer show you how *Texaco Ursa Oils* will protect your Diesel investment. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS **FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES**



This is the Diesel

that speeds the big jobs

HERE IT IS—the newest member of the General Motors Diesel family—the brawny 6-110 engine that develops 275 horsepower.

It is 50% more powerful than the famous 6-cylinder GM "71" engine that powers so many trucks, buses, boats, construction equipment and other mobile, portable and stationary units.

This rugged new Diesel doesn't care what's tied to its tail. It has power to spare to keep big jobs humming, yet is so compact it doesn't hog space.

For example, each new Budd RDC rail car is driven by a pair of 6-110 Diesels with GM torque converter transmissions. The compactness of these power plants permits mounting them under the floor so that no revenue space is lost. These rail cars accelerate from standstill to 44 miles per hour in just one minute and have a top speed of 83 mph with a full load.

Like all other GM Diesel engines the 6-110 is two-cycle—delivers power on every piston downstroke. This advanced design cuts down Diesel size without sacrificing ruggedness; it insures fuel economy, lower maintenance costs, exceptional dependability and long life.

The GM 6-110 engine provides Diesel power at its best for heavy-duty jobs—not only for rail cars but in the largest mountain-type trucks, huge rock crushers, deep-sea fishing and pleasure boats, big pumps and compressors, mining and oil field equipment. *It is an exceptionally compact Diesel for its horsepower—an engine that gives remarkably fine performance in minimum space.*

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES . . . Up TO 275 H. P. **DETROIT 28, MICHIGAN** MULTIPLE UNITS . . . Up TO 800 H. P.

GENERAL MOTORS

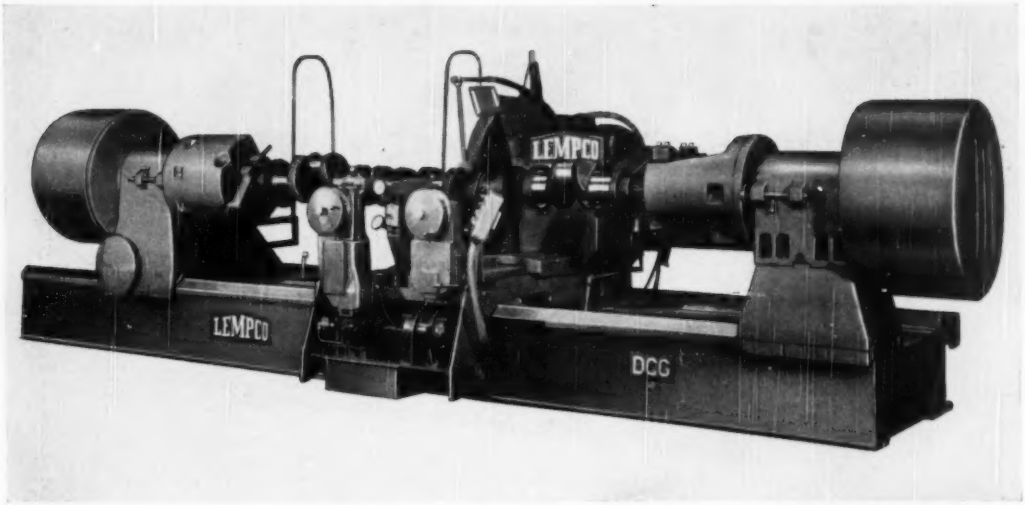
Hear HENRY J. TAYLOR on the air every Monday evening over the ABC Network, coast to coast.

GM GENERAL MOTORS DIESEL POWER

Only GM Diesels provide all these advantages

Compact size—less weight per horsepower . Two-cycle smoothness, power on every downstroke . Quick starting, on its own fuel . Unit injectors—no high-pressure fuel lines . Rapid acceleration . Cleaner burning . Better high-altitude performance . Easy accessibility.

"Your Key to GM Power Economy"



DIESEL CRANKSHAFT GRINDER with the traversing wheelhead *reduces initial investment by 2/3*

The new Lempco Supersize series of Diesel Crankshaft Grinders are approximately half the length of the other big shaft grinders. Yet Lempco machines equal or better the capacities of other makes.

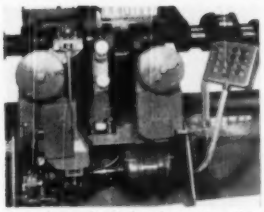
This is made possible by utilizing the same principle Lempco introduced on standard size automotive crankshaft grinders—that of moving the grinding wheel from journal to journal, instead of moving the shaft along the wheelhead.

By combining this savings in overall size with further economies in use of heavy welded steel base, Lempco is able to offer a precision grinder that incorporates more than 20 years of experience in building automotive crankshaft grinders. Write for Bulletin on Diesel Crankshaft Grinder.

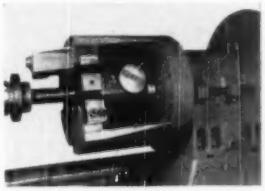
Lempco Products, Inc., 5490 Dunham Rd., Bedford, Ohio

PRECISION-SPEED . . . . FOOLPROOF OPERATION

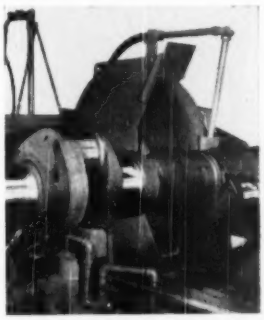
- Hydraulic traverse and infeed of grinding wheel.
- Fine adjustment of grinding wheel made by manual micrometric dial.
- Push-button foolproof control. Automatic Safety Controls.
- Low center of balance offers maximum machine rigidity. Work is ground at operator's eye-level.
- Three models: RCG takes 32" swing and 108" length; DCG takes 40" swing and 178" length; SCG takes 50" swing and 216" length, larger size built to specifications.
- Built on a principle proven by 20 years of production "know-how" in precision machinery manufacturing.



Control panel of the six motors that control the traverse, speed and hydraulic mechanism that operate the diesel crankshaft grinder.



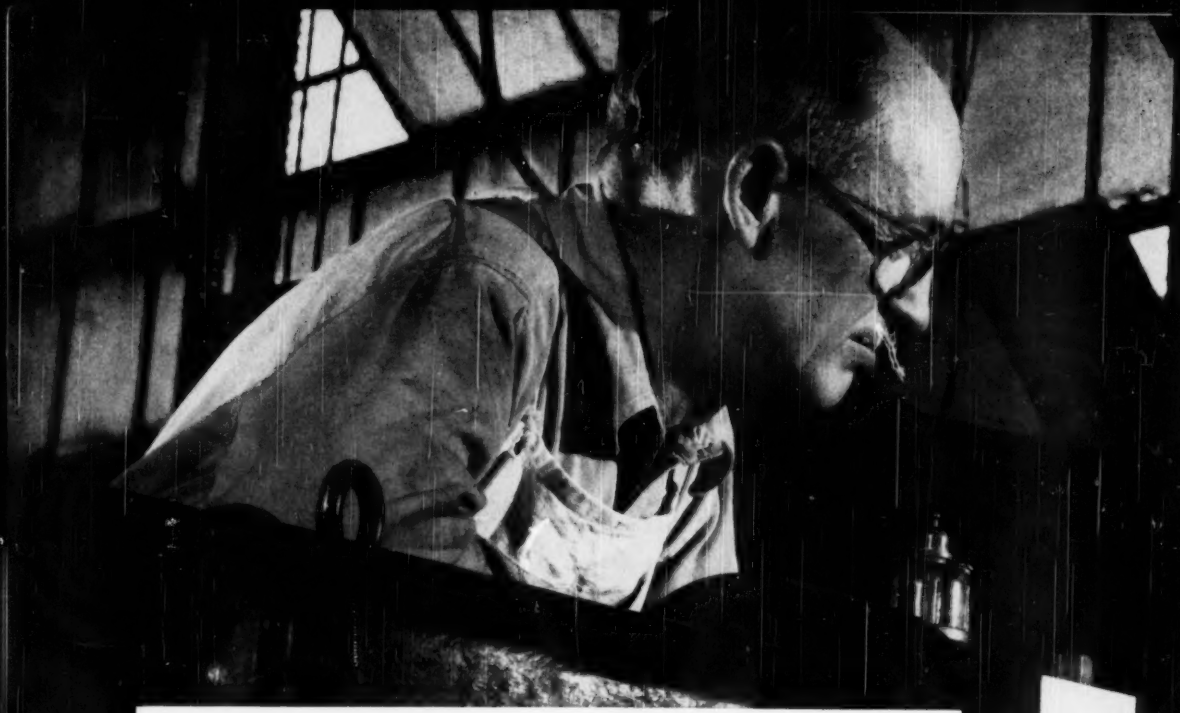
Pot chuck set up to grind main bearings between centers. When crank pins are ground shaft is held inside of chuck.



Showing relative size of grinding wheel and diesel shaft. Coolant floods wheel at point of contact with work.

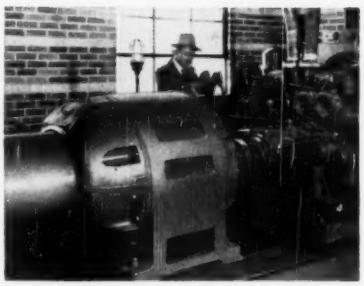
LEMPCO

Maker of world's largest line of Quality Automotive Shop Equipment



His skill, based on 40 years of service, goes into the G-E engine-driven generators you buy

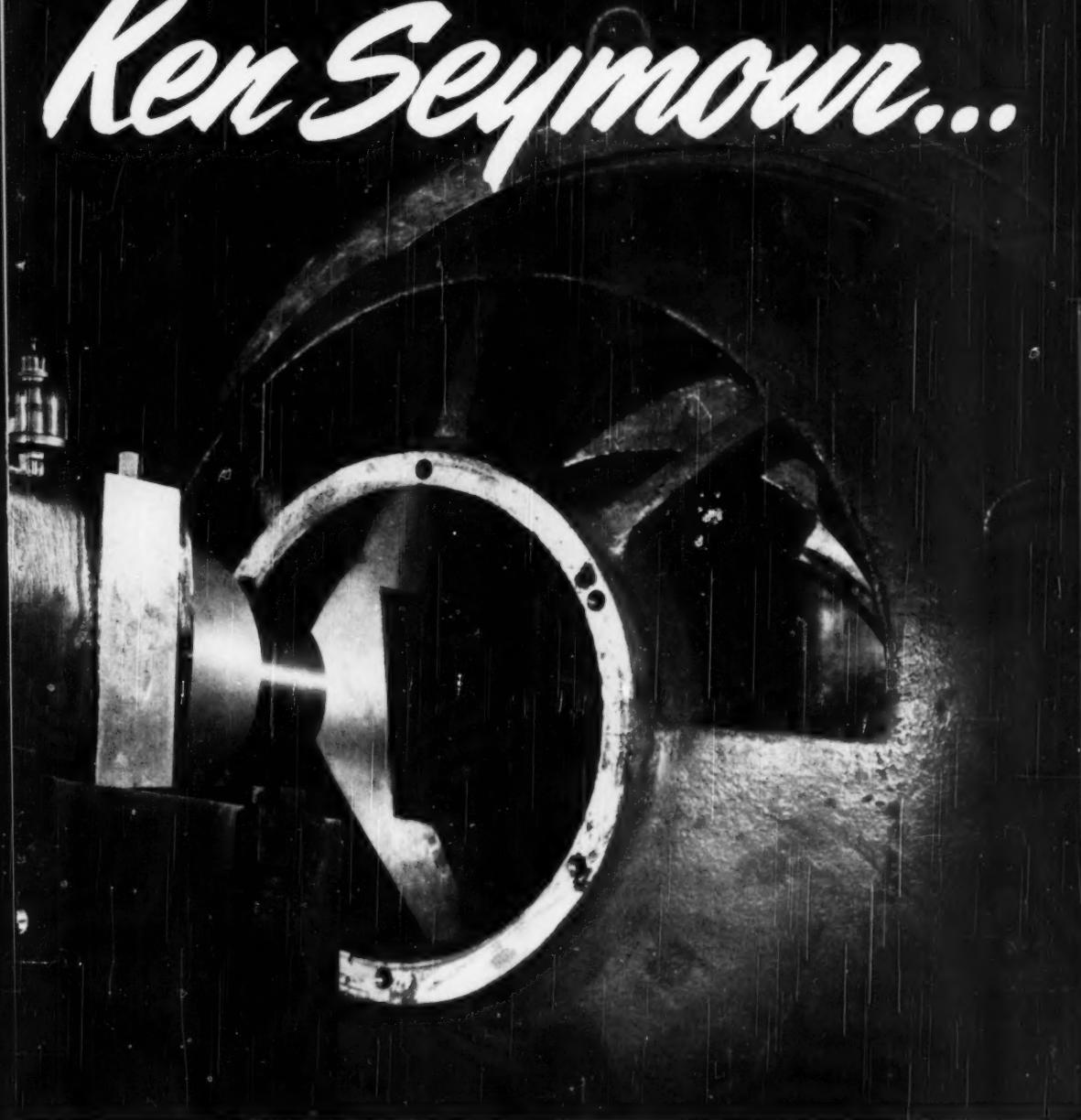
The high quality of thousands of G-E synchronous engine-driven generators now on the job is the direct result of the skills of men like Machinist Seymour. Kenneth has devoted more than four decades to serving G-E customers. Jobs like his call for top-grade craftsmanship to maintain the close tolerances demanded by G-E production standards.



DEPENDABILITY AND HIGH OPERATING EFFICIENCY are characteristic of every G-E synchronous generator. Past performance records of these sturdy, efficient machines have made G.E. a "buy" word for purchasers of power-generation equipment. Apparatus Dept., General Electric Co., Schenectady 5, N.Y.

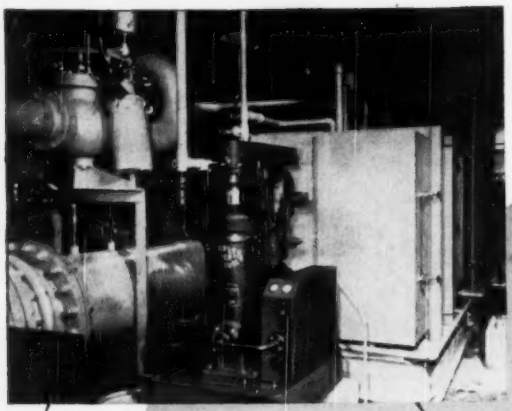
You can put your confidence in—

Meet Ken Seymour...



GENERAL ELECTRIC

770-21



ONE

Sharples Oil Purifier protecting hundreds of thousands of dollars worth of diesel engines

It's not an uncommon sight . . . one small Sharples Oil Purifier continuously and thoroughly purifying the lube oil of an entire battery of huge diesel engines—here is assurance of continuous engine lubricating efficiency and longer oil life, that means important savings from reduced maintenance costs, less down-time for repairs, and lower labor costs.

The Sharples DIESEL OIL PURIFIER for Diesel Lubricating and Fuel Oil

- Removes carbon, sludge, abrasives, scale and water
- IT DOES NOT REMOVE OR HARM THE IMPORTANT ADDITIVES IN LUBE OIL
- Since none of the properties are filtered or strained out—the same lube oil can be re-used many times with absolute safety.
- Requires an absolute minimum of machine attention.
- Can be cleaned and back in service in 15 minutes or less!

Only 3 parts to clean—no discs to scrub—no cartridges to buy or replace.

Sharples OIL PURIFIERS

For Diesel Lube Oil
Or Diesel Fuel Oil

By generating a centrifugal force 13,200 times gravity, the machine purifies oil without filters. It is a complete unit including pump and motor assembly.

It pays both ways to clean Lube Oil with the Sharples Oil Purifier. Protect your engine investment and Lower operating costs.

Write or call The Sharples Corporation TODAY for the complete facts.

Sharples Diesel Oil (Lube & Fuel) Purifiers

PURITY WITHOUT REMOVING THE ADDITIVES

THE SHARPLES CORPORATION

BOSTON NEW YORK PITTSBURGH CLEVELAND DETROIT CHICAGO
NEW ORLEANS SEATTLE LOS ANGELES SAN FRANCISCO HOUSTON

2300 WESTMORELAND STREET • PHILADELPHIA 40, PENNSYLVANIA

ASSOCIATED COMPANIES AND REPRESENTATIVES THROUGHOUT THE WORLD

KOPPERS NEW K-SPUN PISTON RINGS

cut Diesel "Down Time"

Railroads Slash Maintenance Costs with Amazing New KOPPERS Piston Rings

that DOUBLE mileage between overhauls, cut cylinder wear in half!

EVERY DAY, on every road, you can see these rugged Diesels highballing with thousands of tons of freight and passenger cars . . . keeping right on schedule, up grade, down grade . . . through scorching desert heat and icy northern blizzards. It's a job that's plenty hard on engines—and on piston rings! But amazing new Koppers K-Spun Piston Rings take this rough, tough service right in their stride . . . lasting up to *twice as long as ordinary rings!* And that's not all . . . Koppers rings *decrease cylinder wall wear up to 50%!*

Here at last are the piston rings that cut Diesel maintenance costs *in half* . . . lengthen the life span of expensive equipment . . . boost mileage, service *and profits* to a new high! Check into the operating costs of *your* Diesels today . . . and next time you overhaul, specify Koppers Piston Rings . . . then watch costs go *down,* service go *up!*

Koppers complete engineering facilities are at your service. Whatever your piston ring problem may be—steam, Diesel, gasoline engines, pumps, compressors—we can help you solve it quickly and economically. Write: KOPPERS COMPANY, INC., *Piston Ring Department,* 1642 Hamburg St., Baltimore 3, Md.

Only Koppers can furnish K-Spun

What is Koppers K-Spun?

Koppers K-Spun is an entirely new type of ring iron created by an exclusive centrifugal casting process, which forms graphite into large nodules instead of fine flakes. Large graphite nodules in K-Spun cast iron eliminate the many planes of weakness inherent in ordinary cast iron . . . impart to K-Spun *100% more strength, 50% more elasticity, four times more shock resistance!* K-Spun Rings are guaranteed not to break in installation or in service! Available up to 12½" diam.

What is Koppers Porous Chrome?®

Koppers Porous Chrome is a chrome-plated ring with a *porous surface* that holds and distributes oil during break-in, quickly wears down to perfectly seated *solid chrome* that prevents grit or other particles from imbedding in the ring surface and scratching cylinders. Porous Chrome Rings last up to four times as long as ordinary rings, reduce cylinder wear 50% or more! Available in any size on specification in quantities of 100 or more. Do not use against chrome liners.

KOPPERS

KOPPERS *American Hammered* PISTON RINGS

EATON

Zero-Lash

Registered U. S. Patent Office

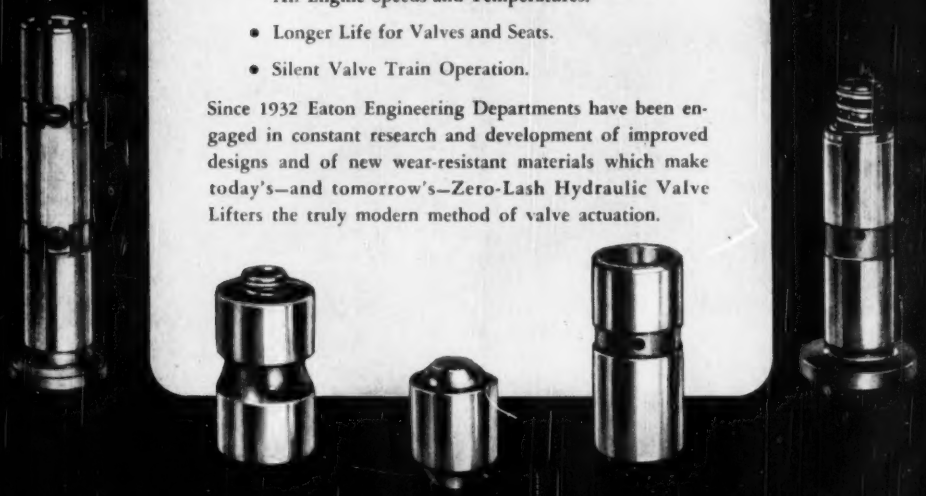
HYDRAULIC VALVE LIFTERS

The Modern Method of Valve Actuation

Millions of Zero-Lash Hydraulic Valve Lifters and Zero-Lash adjusting units—designed and developed exclusively by Eaton Manufacturing Company—have gone into leading automotive, aircraft, tractor, marine and industrial engines in the last 17 years. They have contributed:

- Freedom from Tappet Adjustments for the Life of the Engine.
- Accurate Valve Timing and Perfect Seating at All Engine Speeds and Temperatures.
- Longer Life for Valves and Seats.
- Silent Valve Train Operation.

Since 1932 Eaton Engineering Departments have been engaged in constant research and development of improved designs and of new wear-resistant materials which make today's—and tomorrow's—Zero-Lash Hydraulic Valve Lifters the truly modern method of valve actuation.



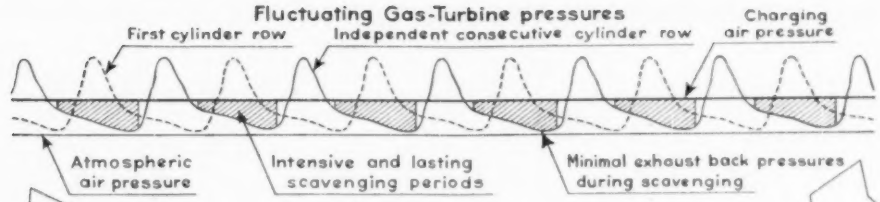
EATON MANUFACTURING COMPANY

CLEVELAND, OHIO

Saginaw Division

9771 French Road · Detroit 13, Michigan

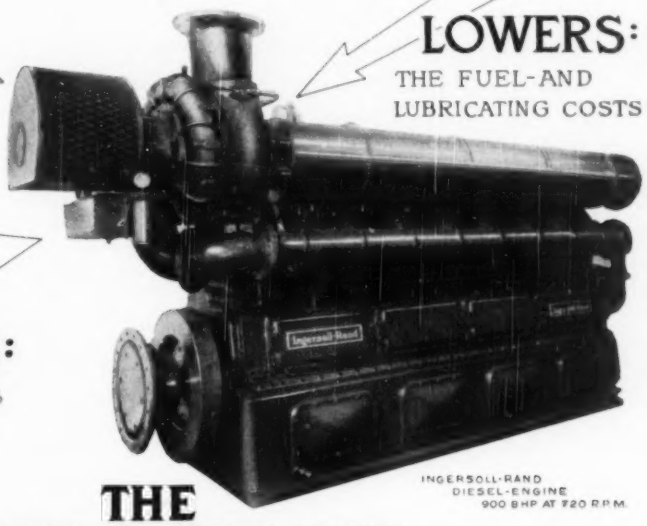
PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS



DECREASES:
THE ENGINE DIMENSIONS, WEIGHT AND COST

LOWERS:
THE FUEL-AND LUBRICATING COSTS

INCREASES:
OUTPUT BY 50 TO 100% AT SEA LEVEL, AT HIGHER ALTITUDE STILL MORE



INGERSOLL-RAND DIESEL-ENGINE 900 BHP AT 720 R.P.M.

THE BUCHI-SYSTEM OF Turbocharging

Engineering Office Dr. Alfred J. Buchi Winterthur, Switzerland

Licensors and Consulting Engineers for Turbocharging of New and Existing Internal Combustion Engines

U. S. OFFICE: 707 MUNSEY BUILDING WASHINGTON 4, D. C.

Firms in U. S. building Oil Engines Exhaust-turbocharged on the Buchi-System:

American Locomotive Co., Diesel Engines and Turbochargers • Baldwin Locomotive Works • Buckeye Machine Co. • Chicago Pneumatic Tool Co. • Cooper-Bessemer Corp. • Elliott Co. (Turbochargers only) • Enterprise Engine & Foundry Co. • Fulton Iron Works Co. • Ingersoll-Rand Co. • Lima-Hamilton Corp. • National Supply Co. (Superior and Atlas Engines) • Nordberg Mfg. Co. • Sterling Engine Co. • Union Diesel Engine Co. • Washington Iron Works • Worthington Pump and Machinery Corp.

the trend is to Diesels — and to

THE PITTSBURGHER, crack train of the Pennsylvania Railroad, leaving the Pennsylvania Station in Pittsburgh on its nightly run to New York City.

GULF DIESELMOTIVE OIL

As recently as January 1949, there were only about 5,600 Diesel locomotives in service on U. S. railroads. Today the figure is over 10,000! And new Diesels are being placed in railway service just as quickly as the manufacturers can produce them.

More and more of these fast and powerful units get the right start for a long life and low maintenance costs with a crankcase fill of Gulf Dieselmotive Oil. Many of the Diesel locomotives for the crack trains of the Pennsylvania Railroad, for example, are lubricated with Gulf Dieselmotive. This outstanding oil keeps Diesel engines clean, prevents bearing corrosion, foaming, and excessive wear.

Gulf Dieselmotive Oil is one of a family of outstanding Diesel lubricating oils which includes Gulfpride-Diesel and Gulflube Motor Oil H.D. for automotive Diesel engines; Gulf Parvis Oil and Gulf Universal Oil for stationary and marine Diesel engines.

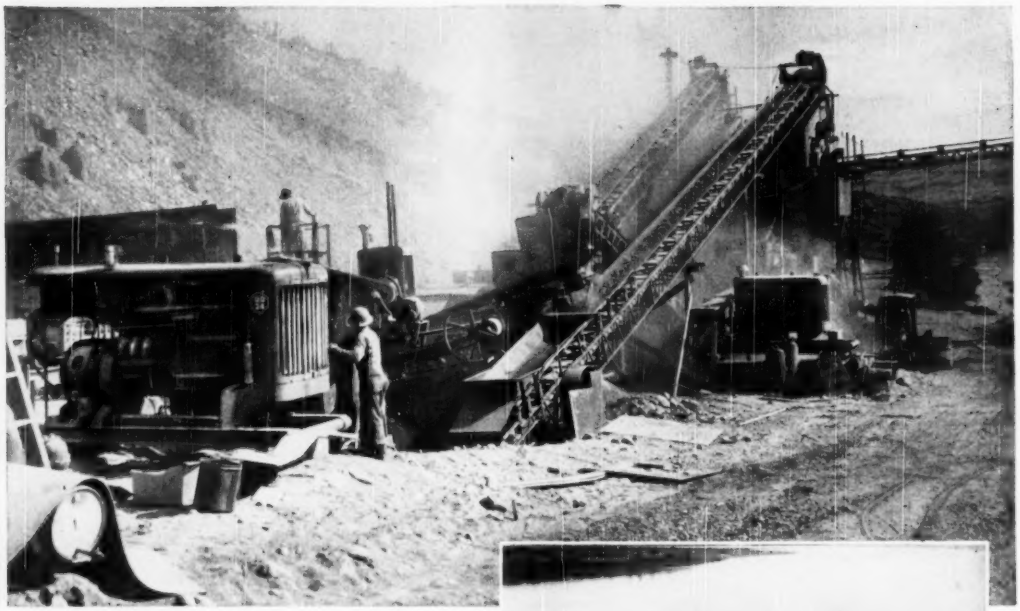
For further information on Gulf Diesel lubricating oils and for practical help on any Diesel lubrication or maintenance problem, call in a trained Gulf Lubrication Engineer. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company

GULF BUILDING, PITTSBURGH, PA.

Sales Offices - Warehouses

Located in principal cities and towns throughout Gulf's marketing territory



"International Diesels have POWER and ENDURANCE!"

. . . says Dave Sholseth, superintendent of Strong & McDonald's rock crusher near Monse, Washington. He knows from experience that the dependable Internationals can always be counted on to deliver thousands of work-hours without trouble.

The Strong & McDonald plant gets its power from two International UD-24 Diesels, one on a crusher, the other driving a generator, plus an International UD-18 Diesel and an International UD-14A Diesel driving crushers. In addition an International UD-14 is used as auxiliary power. The plant produces various sizes of crushed rock and averages about 200 yards an hour.

Mr. Sholseth says, "We have good luck with all our Internationals. The oldest one on the job (8,000 hours of work) hasn't even had the pan removed from the crankcase as yet."

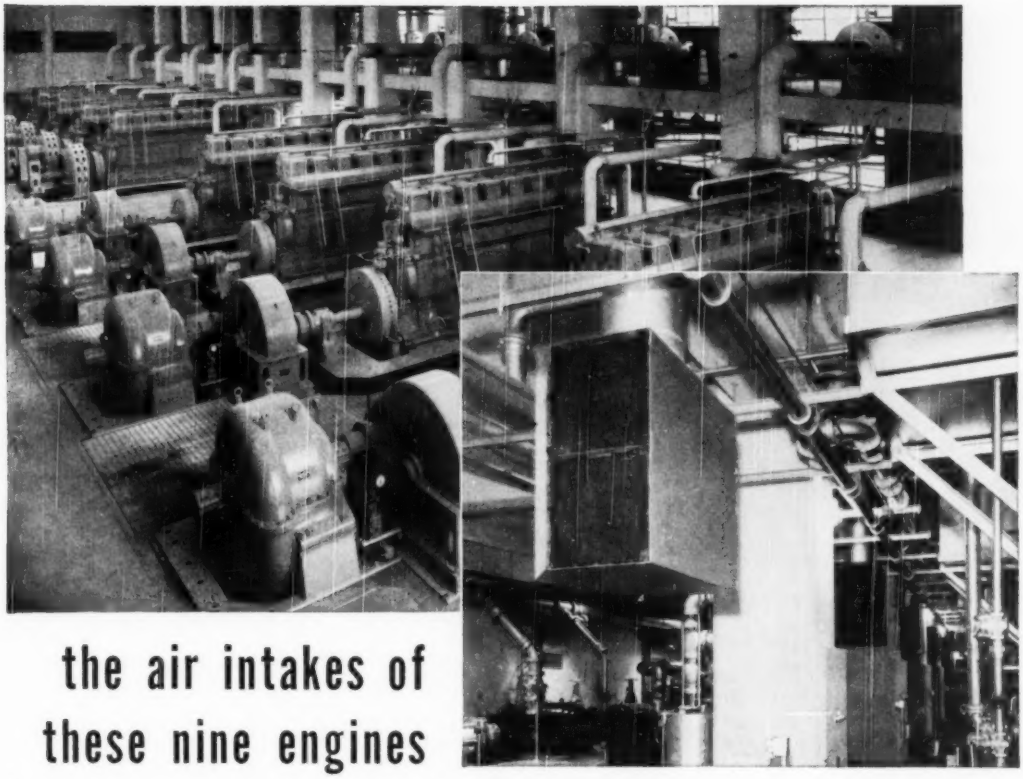
A visit to your International Industrial Power Distributor will convince you that Mr. Sholseth's story of power and endurance is not unusual. You'll see all the advanced engineering features that combine to make International Diesels the choice of diesel power everywhere. See your nearby Distributor for complete information.

INTERNATIONAL HARVESTER COMPANY • CHICAGO 1, ILLINOIS

CRAWLER TRACTORS
WHEEL TRACTORS
DIESEL ENGINES
POWER UNITS

INTERNATIONAL HARVESTER

INTERNATIONAL
INDUSTRIAL POWER



the air intakes of these nine engines have **AAF FILTER PROTECTION** at Hyperion Sewage Disposal Plant

THE HYPERION SEWAGE DISPOSAL PLANT in Los Angeles is one of the finest systems of its kind in the world. No expense has been spared in the facilities or equipment—AAF Electro-Matic Self-Cleaning Electronic Precipitators were used to provide super-clean air for the activated sludge process—AAF Type OCH Filters were selected to clean the intake air for the nine big engines that serve the power needs of this plant.

Type OCH is one of several types of AAF filters designed for cleaning the intake air for engines and compressors. At Hyperion they clean inside air which has already been cleaned by the ventilating filters—proof of AAF's high efficiency in removing dust and dirt from the air.

Any expensive engine needs the kind of protection AAF can deliver. And if you have a special problem, just call on AAF's engineers. Their experience has benefited thousands.

WRITE TODAY for complete information on the different types of AAF filters for engines you build, own or operate.

Today's Best Buy is Better Air!

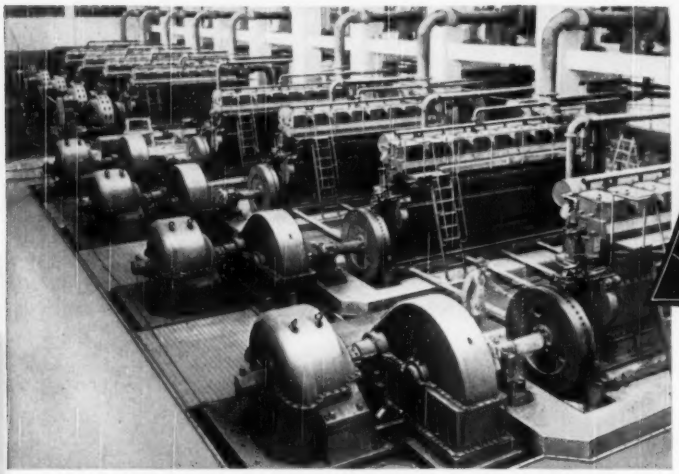
AAF

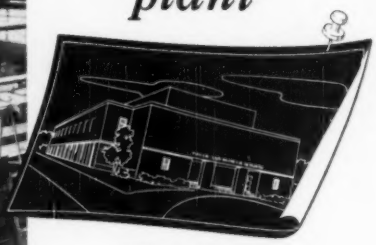
American Air Filter

COMPANY, INC.

445 Central Avenue, Louisville 8, Kentucky • In Canada: Darling Bros., Ltd., Montreal, P. Q.

EXCEPTIONAL LOW POWER COST for huge new Los Angeles sewage disposal plant





Worthington Supercharged Dual Fuel Engines to Supply 15,000 hp . . . for only the cost of pilot fuel!

Nine Supercharged, Dual Fuel Worthington Engines, of 1688 hp each, installed at the new Hyperion Sewage Treatment Plant, Los Angeles, California

Now being built at a cost of approximately $41 million, Los Angeles' new Hyperion sewage disposal plant will be the most modern and efficient in the world. Designed to handle an average daily flow of 245 million gallons of raw sewage, this modern "high-rate" plant will feature the most advanced engineering in every detail of operation.

Nine Worthington Dual Fuel engines are to be the entire power source. Five will drive generators, and the other four will drive blowers. The Hyperion plant will operate at exceptionally low cost, thanks to: (1) the Worthington-pioneered dual fuel principle, permitting the use of gas, oil, or gas and oil in any ratio; (2) supercharging, which provides maximum power for available space, and with the utilization of high-temperature water cooling and exhaust heat recovery system, results in highest thermal efficiency.

SEWAGE GAS THE FUEL

These Worthington engines will normally run on raw sewage gas, utilizing pilot oil to ignite the gas. *Fuel expenses under ordinary conditions, therefore, will be only the cost of pilot oil.* However, should there ever be a shortage of sewage gas, the engines will automatically shift to oil fuel, in the necessary ratio. This gas-oil ratio can also be controlled manually.

FOR EVERY SIZE OF PLANT

In addition to Dual Fuel Engines, Worthington makes a wide range of Diesels, pumps, comminutors, and other equipment, to meet the requirements of sewage treatment plants of every size from the smallest to the largest. For further facts on the trouble-free, cost-saving engine performance that proves *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

WORTHINGTON

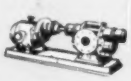
EO-1

YOUR PARTNER IN POWER PROGRESS

WORTHINGTON-BUILT AUXILIARIES

Diesel engines, 150 to 3,520 hp . . . gas engines, 175 to 3,520 hp...dual fuel engines, 225 to 3,290 hp.

Balanced Angle Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Cooler

Alnor Protection

EXTENDS THE LIFE LINE OF YOUR DIESEL

To assure continued high efficiency, every diesel should have the best protection against maladjustment and wear. Alnor Exhaust Pyrometers provide this protection by giving an instant check on all cylinders, anticipating trouble from preignition, detonation, overloading, or breakdown of lubrication, etc. Modern design and rugged construction assure accurate, reliable instrument service on any installation, large or small, even under severe operating conditions.

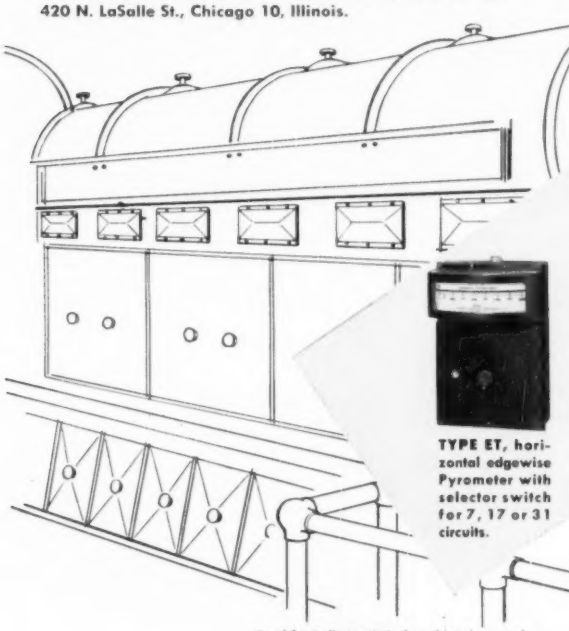
Such constant protection reduces maintenance time and expense to a minimum—increases efficiency and operating economy. Alnor Pyrometers are low cost, easy to install on old or new engines. Ask your Alnor Representative to assist you in selecting the right equipment from the full line of Alnor Exhaust Pyrometers and special thermocouples. Illinois Testing Laboratories, Inc., Room 507, 420 N. LaSalle St., Chicago 10, Illinois.

TYPE RT, switchboard type flush or surface mounting with switch for 8, 17 or 31 circuits.

TYPE BZ, for switchboard, wall or bracket mounting, with switch for 8 or 17 circuits.

TYPE FAX, for switchboard or flush mounting, with switch for two to 16 circuits.

TYPE ET, horizontal edgewise Pyrometer with selector switch for 7, 17 or 31 circuits.



Send for Bulletin 4361, describing the complete Pyrometer line. Use this handy coupon.

Illinois Testing Laboratories, Inc.
Rm. 507, 420 N. LaSalle St.,
Chicago 10, Illinois

Please send me a copy of Bulletin 4361.

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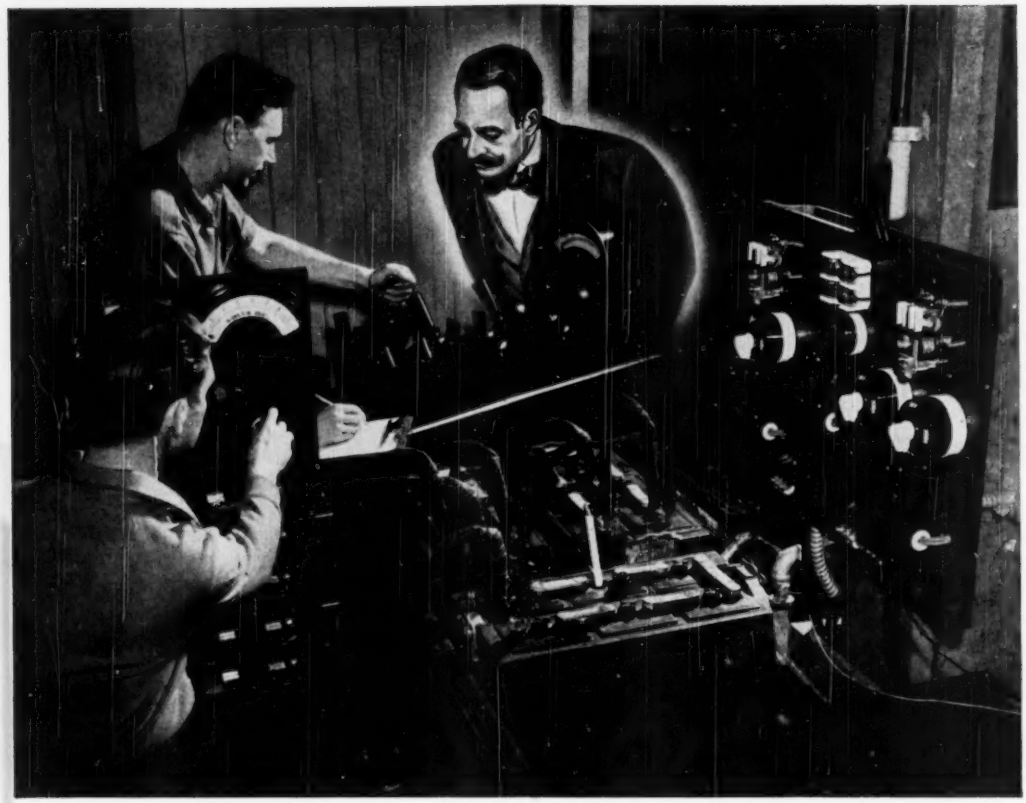
Company.....

Address.....

City..... Zone..... State.....

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY



This overcharge test, Mr. Diesel, proves that Exides can "give it and take it"

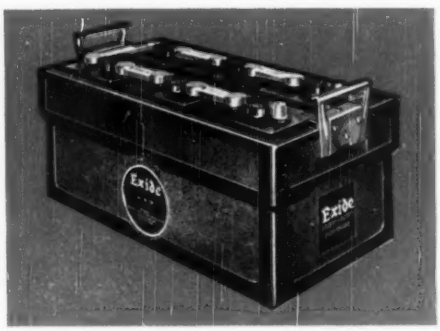
The Exide overcharge test is rough and rugged. Plates and separators are subjected to *continuous* overcharge . . . not for a short time, but as long as 48 weeks, and at an average temperature of 100° F. The purpose: to *make certain* that Exide Batteries give you maximum service life.

Results of this and other tests prove that you can count on Exide Diesel Cranking Batteries for:

- high maintained voltage—a *quick breakaway* and *high cranking speeds.*
- long life—low depreciation, less frequent replacements.
- low costs—operating, maintenance, repair.
- ruggedness for heavy-duty service in all climates.

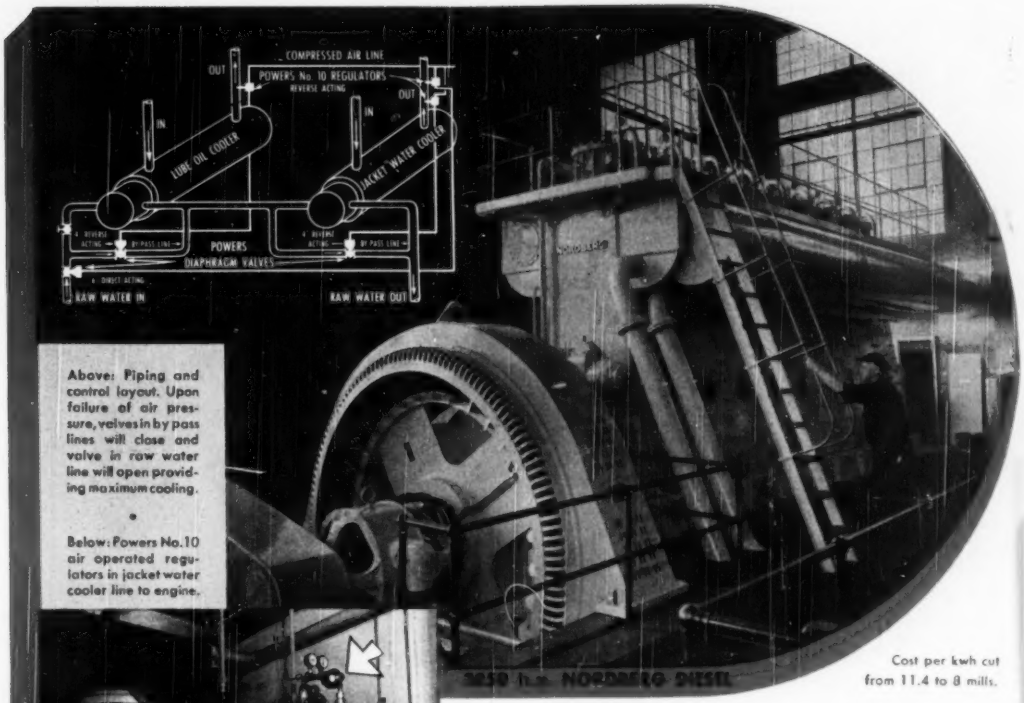
Get top performance, long battery life and economy with Exide Batteries. Use them for all your Diesel cranking—buses, trucks, trailer-tractors, off-the-highway equipment, ships, power plants, Diesel-electric locomotives.

LET EXIDE'S ENGINEERING STAFF, the largest in the industry, help you find the right answer to any Diesel cranking problem.



THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto
"Exide" Reg. Trade-mark U. S. Pat. Off.

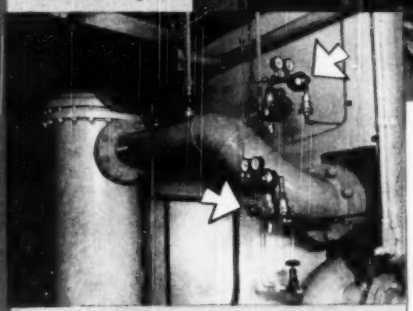
1888 . . . DEPENDABLE BATTERIES FOR 62 YEARS . . . 1950



Above: Piping and control layout. Upon failure of air pressure, valves in by pass lines will close and valve in raw water line will open providing maximum cooling.

Below: Powers No. 10 air operated regulators in jacket water cooler line to engine.

Cost per kwh cut from 11.4 to 8 mills.



Below: Powers pneumatically controlled valves

POWERS Pneumatic Temperature Controls Help Freeport, N. Y. Light and Power Plant Reduce Costs and Increase Efficiency

With a total capacity of 17,310 h.p., Freeport, N. Y. has one of the largest municipally owned diesel-electric plants in the United States. Knowing the importance of accurate regulation of jacket water and lube oil temperatures, Chief Engineer Thomas Moore selected Powers compressed air operated controls for the Nordberg Diesel shown above, which has reduced cost per kwh 30%.

Greater Safety and Reliability of Powers pneumatic control assures correct jacket water and lube oil temperature regardless of load or seasonal changes. Accurate temperature control—improves lubrication, cylinder liner wear and reduces piston ring replacements; minimizes danger of piston seizure and sludging, reduces fuel and lube oil consumption. Cost? . . . about the same as a set of new piston rings.

With both pneumatic and self-operated regulators we may be able to help you select the type that will give better temperature control. Fill out coupon below. There's no obligation.

THE POWERS REGULATOR CO. *Established 1891. Offices in Over 50 Cities, See Your Phone Directory*

MAIL TO

(D-10)

The Powers Regulator Co., 2710 Greenview Ave., Chicago 14, Illinois

Have engineer call to study our requirements for better jacket water temperature control.

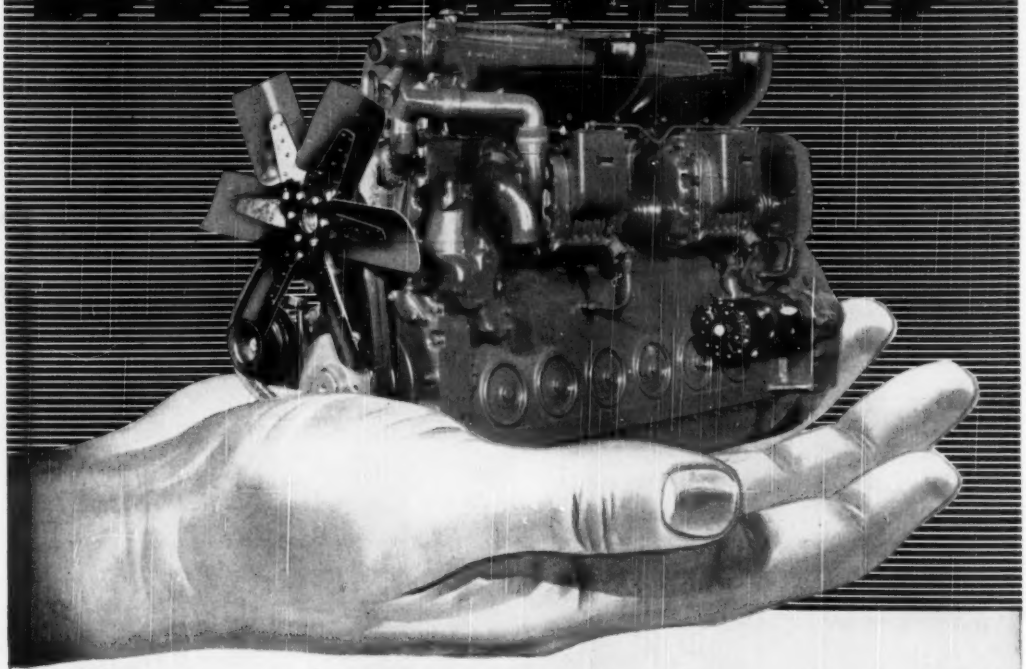
Name of Engine or Compressor ..... HP .....

Your Name .....

Address .....

City ..... State .....

LIGHTWEIGHT



P&H DIESEL ENGINES

(2 CYCLE)

Now, for the first time, a line of diesel engines in which *all* major castings are of lightweight alloys. This is what you have waited for . . . *less weight per horsepower,* rugged design for the toughest jobs . . . proved performance. And longer life, too! Write for literature. Diesel Division, Harnischfeger Corp., Port Washington, Wis.

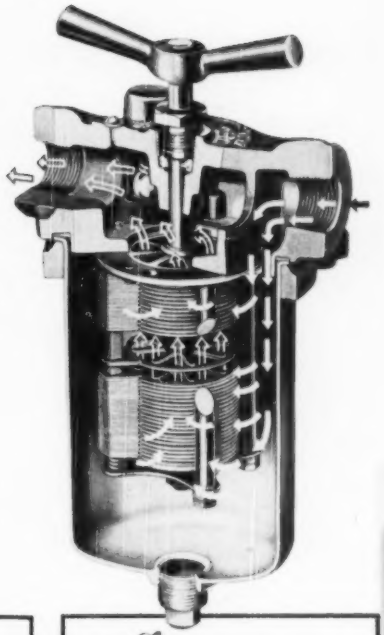
P&H DIESEL DIVISION

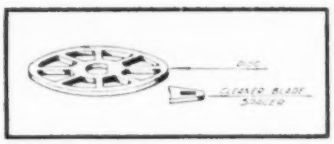
HARNISCHFEGER CORPORATION

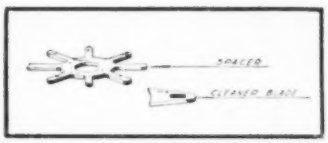
PORT WASHINGTON WISCONSIN, U. S. A.

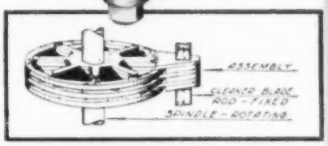
SAVE $15,000 REPAIR BILL

with this exclusive, continuously-cleanable strainer









NON-STOP CLEANING—*Turning metal discs past cleaner blades (periodically by hand or continually by motor or other automatic means) "combs out" all solids—even when embedded in strainer element—without interrupting flow.*

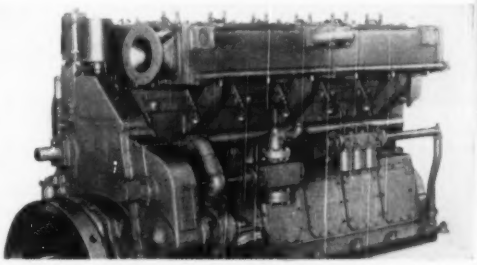
Protect your Diesel against scoring of bearings, crankshafts and cylinders . . . by using Cuno AUTO-KLEAN to clean full flow.

Unlike any other fluid-cleaning device, Cuno AUTO-KLEAN is continuously cleanable without stopping the engine. An occasional turn of a handle—while in operation—combs out dirt accumulations. Single unit installation saves cost.

Permanent metal construction eliminates trouble and expense of replacement parts. No screen or wire cloth to wear or break in cleaning.

For permanent, positive Diesel protection, install compact Cuno AUTO-KLEAN, guaranteed to remove *all* particles larger than spacing specified.* Straight line connections for simplicity of installation on either fuel or lube lines.

**Models available for straining from .0035 to .062 in.*



BUILT-IN OR EXTERNALLY MOUNTED—*Cuno AUTO-KLEAN Strainers are available for built-in or external installations, handling full flow in minimum space.*

Send coupon for information

on cleaning BOTH Lube and Fuel

CUNO ENGINEERING CORPORATION
254 South Vine Street, Meriden, Conn.

Please send me free bulletin on Cuno AUTO-KLEAN Strainer for Diesel engine protection.

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Company.....

Address.....

City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

No Fluid Is Better than Its Filtration

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Complete Line Fluid Conditioning

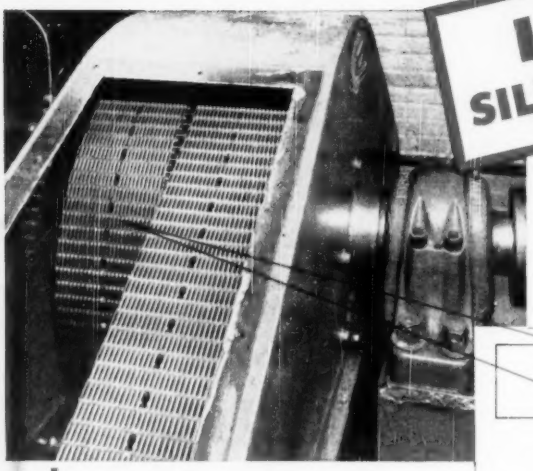
Removes More Sizes of Solids from More Types of Fluids

MICRONIC Micro-Klean • DISC-TYPE Auto-Klean • WIRE-WOUND Flo-Klean

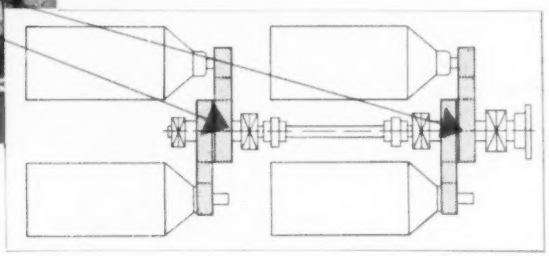
Four-in-Hand Hitch for 700 H. P.

They all pull their share with . . .

LINK-BELT SILENT CHAIN DRIVES



Four 175 h.p. Cummins Diesel engines made into a foursome multiple engine unit by Russel-Hipwell Engines Ltd., are connected by four Link-Belt Silverstreak Silent Chain Drives to a central drive shaft which is connected to a generator. Photo shows casing cover removed from two of these chain drives. Diagram shows relative location of engines and drives.



POSITIVE

As the chain, in the form of a flexible rack, meshes with the teeth of the sprocket, the drive cannot slip.

FULL PRODUCTION

Driven machines operate at rated speed, produce at rated capacity.

NO DETERIORATION

All steel enclosed, Silverstreak Silent Chain Drives are unaffected by temperature, atmosphere or periods of idleness.

PRACTICALLY NO ATTENTION

Drives operate for years at full efficiency with a minimum of maintenance.

PRE-SELECTED STOCK DRIVES

Chains and sprockets for drives from ½ to 50 h.p. are available from stock at Link-Belt distributors or factory branch stores in all principal cities.

Carrying heavy loads at high speeds, Link-Belt Silverstreak Silent Chain Drives give a striking demonstration of extreme precision coupled with great strength. Add long life and negligible upkeep expense and you have the answer to why Link-Belt Silent Chain Drives are popular with profit-minded operators.

LINK-BELT COMPANY

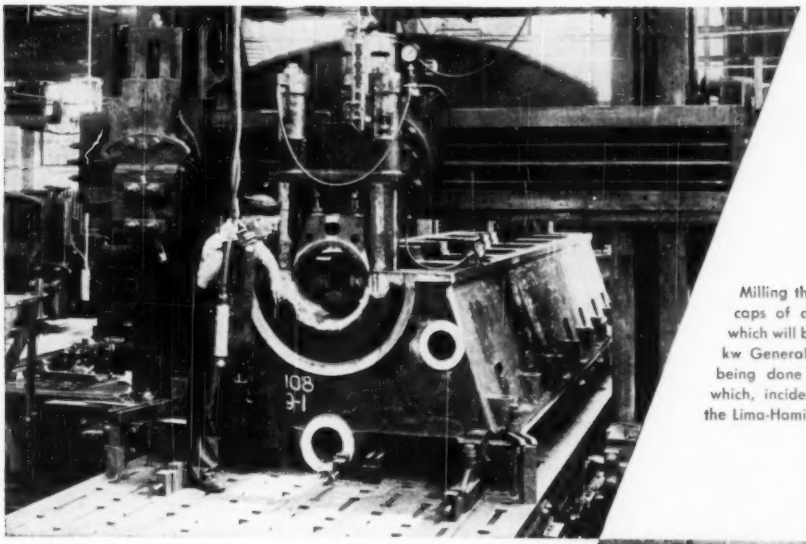
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices in Principal Cities.

12,177

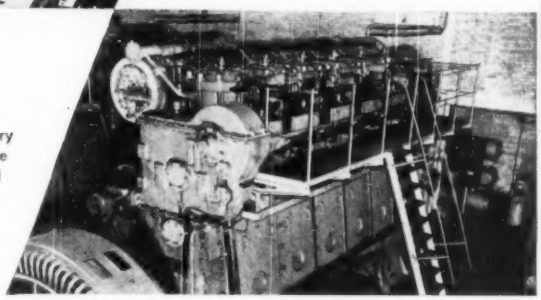
LINK-BELT

Silverstreak

SILENT CHAIN DRIVES



Milling the main bearing saddles and caps of a 6-cylinder Hamilton diesel which will be direct-connected to a 2000-kw General Electric generator. Work is being done on a Niles 10-foot planer which, incidentally, is also a product of the Lima-Hamilton Corporation.



The Anaconda diesel, when installed, will look very much like this 6-cylinder 2250-hp Hamilton engine at Harwood, N. D. The generator, however, will be d-c to supply power for electrolytic refining of copper.

How perfect bearing alignment is achieved on

HAMILTON DIESELS

This casting, approximately 22 feet long and weighing 20 tons, is the bed plate of a Hamilton diesel being built for Anaconda Copper Mining Company. It will be delivered late this fall, to power a General Electric 2000-kw, 250-volt, 250-rpm direct-current generator.

The significance of the photograph is this: It shows how perfect bearing alignment is achieved on Hamilton diesels.

The bed plate is completely planed. Then a milling head is mounted on the cross rail of the planer, and without disturbing the setting of the bed plate, the bearing shell saddles are milled. This is done with the caps in place — *under exactly the same conditions which prevail when the engine is operated.* Thus perfect alignment is obtained.

Such precision in manufacture pays off in lower maintenance for the user.

* * *

Hamilton diesels, with 21½ inch bore and 27½ inch stroke, are available with 5 to 12 cylinders. Ratings are 482½ bhp (net) per cylinder as a straight diesel and 455 bhp per cylinder as a dual fuel engine, both at 257 rpm. For full information, call the Lima-Hamilton Sales Offices in New York or Chicago, representatives in other cities, or write directly to Lima-Hamilton Corporation, Hamilton, Ohio.

LIMA HAMILTON CORPORATION

HOOVEN, OWENS, RENTSCHLER CO. **HAMILTON, OHIO**

a division of the Lima-Hamilton Corporation

MADISON-KIPP *Fresh Oil* LUBRICATORS

. . . provide the most dependable method of lubrication ever developed

Oil under pressure fed drop by drop from a Madison-Kipp Lubricator will definitely increase the production potential for years to come when applied as original equipment on new machine tools, work engines, and compressors. There are six popular models for every application. Write for special engineering data for your particular requirement.

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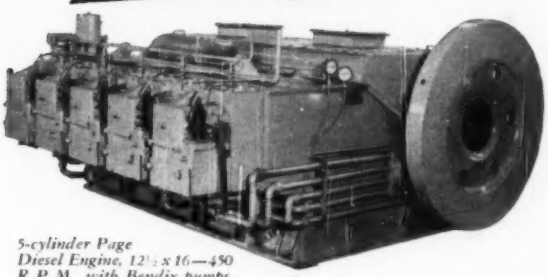
ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

WHERE IT'S

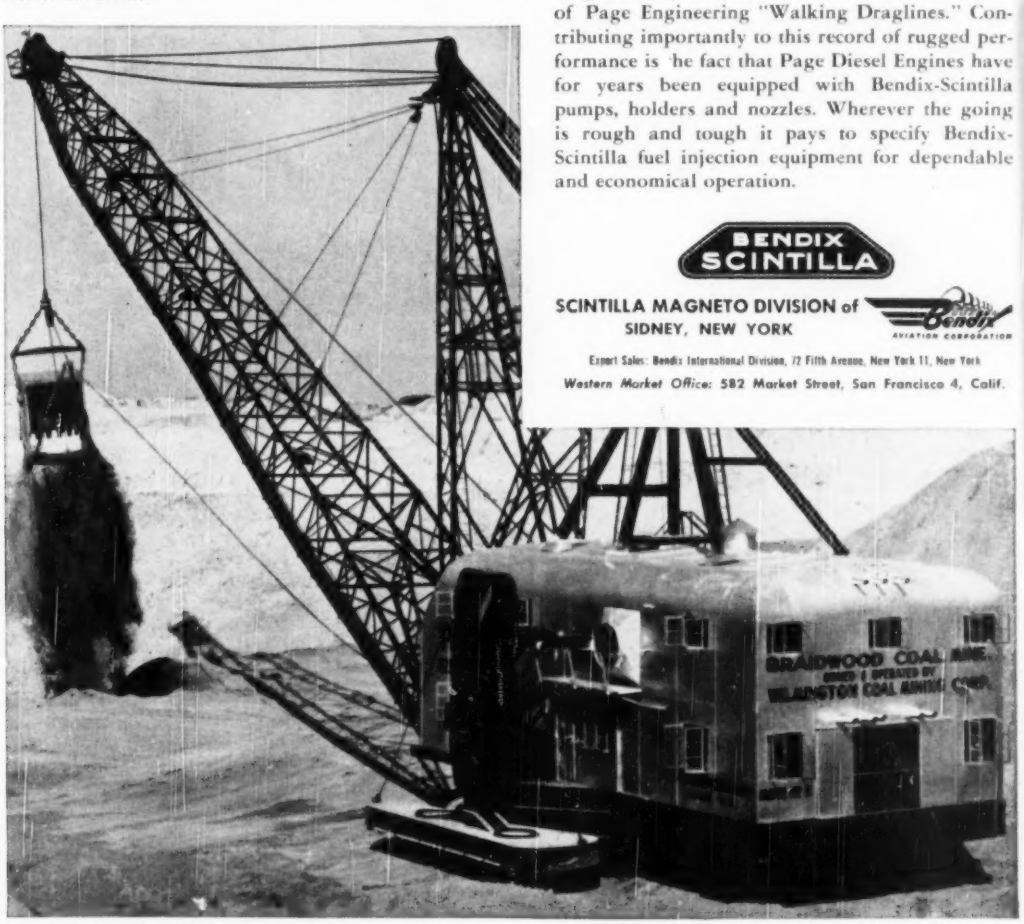
Rough and Tough!



5-cylinder Page Diesel Engine, 12½ x 16—450 R. P. M., with Bendix pumps, holders and nozzles.

Page Diesel-Powered "Walking Draglines" Use Bendix-Scintilla Fuel Injection Equipment

Day in, day out, dependable operation on the toughest kind of jobs—that's the work schedule of Page Engineering "Walking Draglines." Contributing importantly to this record of rugged performance is the fact that Page Diesel Engines have for years been equipped with Bendix-Scintilla pumps, holders and nozzles. Wherever the going is rough and tough it pays to specify Bendix-Scintilla fuel injection equipment for dependable and economical operation.



BENDIX SCINTILLA

SCINTILLA MAGNETO DIVISION of SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, New York

Western Market Office: 582 Market Street, San Francisco 4, Calif.

TIDE WATER ASSOCIATED Salutes...

the Lehigh Valley Railroad's New Diesel-Electric Tug Fleet

The most modern tug fleet in New York Harbor... part of Lehigh Valley's forward thinking in supplanting outmoded equipment with faster, more economical motive power on both land and water.

Tide Water Associated is proud that the Lehigh Valley Railroad selected Tycol Diesel oils and fuels to service these outstandingly fine boats.

Thoroughly familiar with the problems involved in Diesel engine operation, Tide Water Associated has worked uninterruptedly for many years to develop new and better lubricating oils and fuels for more efficient and economical operation.

There is a complete line of Tycol lubricants... over which Tide Water Associated has complete control... from drilling field, through transportation to refineries, where only the most advanced refining processes are employed. This complete control enables Tide Water Associated to produce exceptional high-quality, specialized oils that provide peak efficiency and lowest operating costs.

For example, the new Tycol Adeltran Oils were developed expressly to meet the specific needs of railroad, and certain marine and stationary Diesel operation.

Your nearest Tide Water Associated office will gladly help you select the lubricant... or fuel oil... best suited to the requirements of your particular operation.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago
Detroit • Tulsa • Cleveland
San Francisco • Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

First and foremost in desirable qualities which a generator must have is *dependability*. And Delco generators have this sought-after characteristic to a degree which has caused their selection by Diesel equipment manufacturers the country over.

Next, *low cost* is the chief consideration. Not favorable initial cost alone, but favorable cost per year, which encompasses initial cost plus upkeep, divided by years of operation. It is here that Delco generators rate high . . . advantages in design and the inclusion of normally considered "extras" at no extra cost, pay off handsomely for the ultimate owner.

The power range of Delco generators for Diesel stand-by and portable equipment is from 20 through 200 KW—AC and DC—1200, 1500 and 1800 RPM. Any of the sales offices listed below will be glad to supply detailed information.

DELCO GENERATORS

DELCO PRODUCTS • Division of General Motors Corporation, Dayton, Ohio

SALES OFFICES: CINCINNATI • CHICAGO • CLEVELAND • DETROIT • HARTFORD • PHILADELPHIA

DIESEL-ELECTRIC LOCOMOTIVE

BY C. F. FOELL
AND M. E. THOMPSON

THE BOOK FOR THE "AGE OF DIESEL" IN RAILROADING

658 PAGES—560 ILLUSTRATIONS

Yes, the trend today is to Diesel in the railroad field. And with this extraordinary volume on the DIESEL-ELECTRIC LOCOMOTIVE, you have the most up-to-date and comprehensive treatment of this field that is obtainable.

Here you'll find the railroad Diesel from A to Z; its history, advantages, engineering, construction, operation, principles of maintenance and selection to meet varying conditions of expected use. It is a basic handbook designed to answer every conceivable problem. At the same time, it is keyed to the practical conditions of operation, and discusses and presents all the specific types of engines.

Railroad officials call this the most genuinely useful book on Diesel railroading they have seen. It is an invaluable guide that enables you to have at your side, at very low cost, the answers to every question that may arise to puzzle you.

TABLE OF CONTENTS

History and Development—Advantages—Classes of Locomotives:—Construction and Parts—The Engine-Generator Assembly—Traction Motors and Final Drive—Propulsion Control, Main and Accessory—Power Plant Controls—Locomotive Selection—The Diesel Cycle—Diesel Engines, Types and Styles—Locomotive Diesel Engines—Fuels and Combustion—Fuel Systems, Jerk Pump Types, Distributor and Common-Rail Types—Lubricants and Lubrication—Major Locomotive Accessories—Trucks, Brakes—Mechanical and Hydraulic Drive Diesel Locomotives—Engineering Fundamentals, Mechanical, Magnetic and Electrical—Maintenance of Engine, Generators, Motors, Auxiliary Electric and Mechanical Items.—Notes on Operation and Maintenance.

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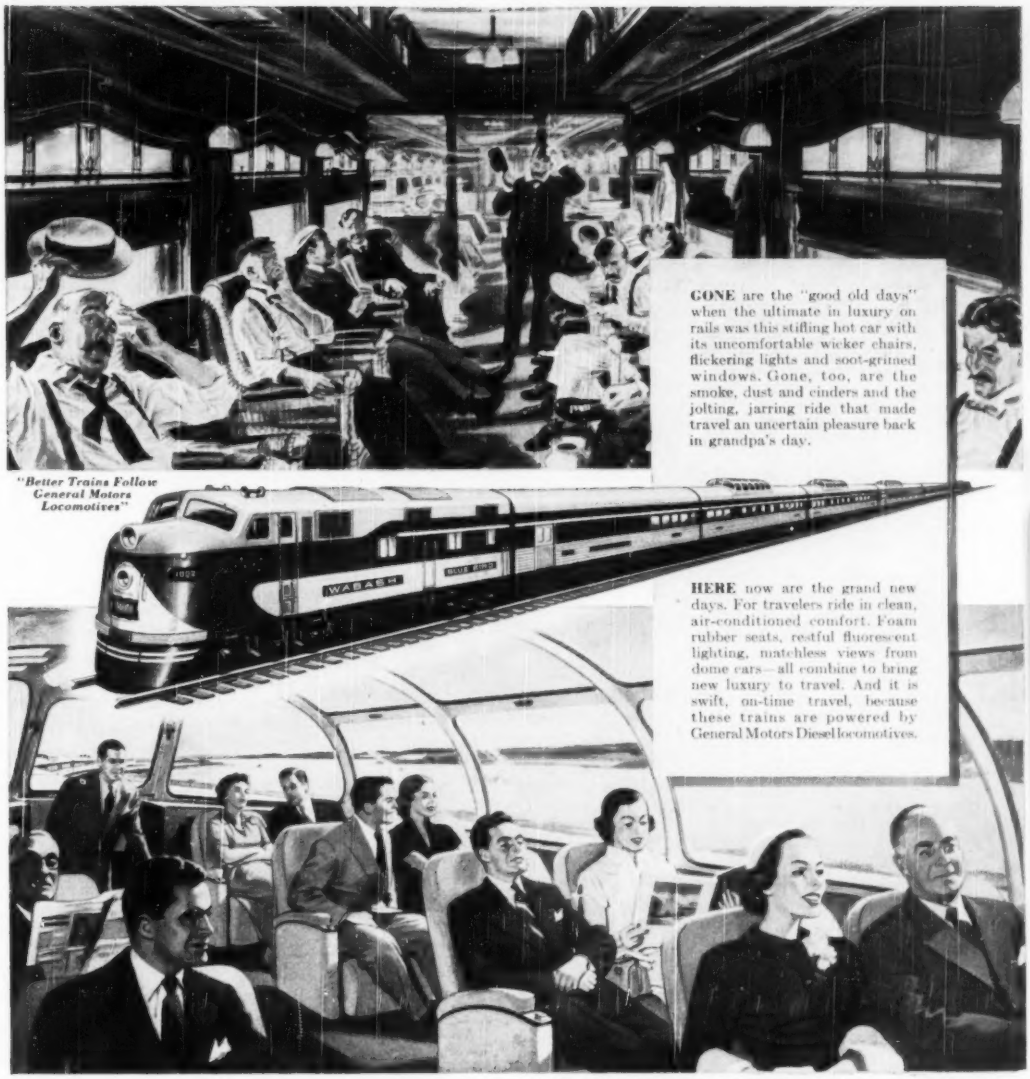
"Better Trains Follow General Motors Locomotives"
WABASH
BLUE BIRD
GONE are the "good old days" when the ultimate in luxury on rails was this stifling hot car with its uncomfortable wicker chairs, flickering lights and soot-grimed windows. Gone, too, are the smoke, dust and cinders and the jolting, jarring ride that made travel an uncertain pleasure back in grandpa's day.
HERE now are the grand new days. For travelers ride in clean, air-conditioned comfort. Foam rubber seats, restful fluorescent lighting, matchless views from dome cars—all combine to bring new luxury to travel. And it is swift, on-time travel, because these trains are powered by General Motors Diesel locomotives.

Latest addition to the ever-growing roster of trains powered by General Motors locomotives is the Wabash Blue Bird, operating daily between Chicago and St. Louis—with new luxury, comfort, speed and safety.

You'll find new smoothness, new comfort, new cleanliness and more real pleasure wherever you travel by rail if you pick a train powered by a General Motors Diesel locomotive. Today that choice is easy, because everywhere you go you'll find that better trains follow General Motors locomotives.

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS • LA GRANGE, ILL. *Home of the Diesel Locomotive*

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GM GENERAL MOTORS LOCOMOTIVES

STANDARD ENGINEER'S REPORT

DATA

PRODUCT Chevron Starting Fluid

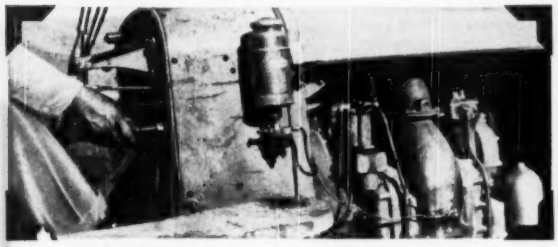
UNITS A.C. diesel engines HD-7 tractors

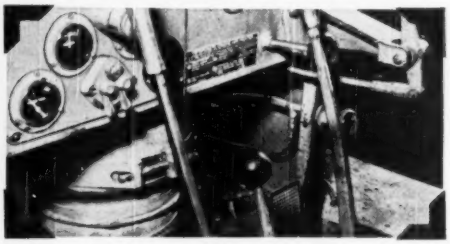
CONDITIONS 25° below zero weather—parked in open shed

EQUIPMENT Permanent primer with atomizers on blower

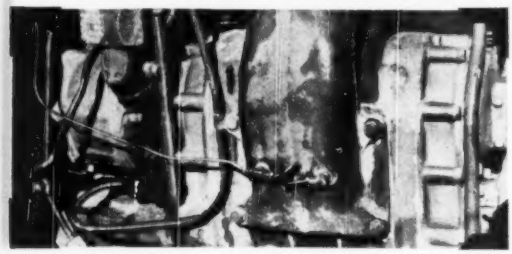
FIRM John W. Graves Heppner, Oregon

Engine starts on first turn at 25° below zero!



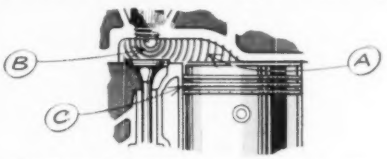


CHEVRON STARTING FLUID started this engine instantly every time during a severe Oregon winter, even when the tractor had been idle for several days in temperatures down to 25° below zero! John W. Graves, owner, says, "Power in the starter battery would last only for two or three revolutions of the engine, but Chevron Starting Fluid required only one turn to kick it off." With one or two strokes of the dash-mounted pump, fluid was forced from the storage tank (left center) into the "blower", before the starter button was pushed.



ATOMIZER NOZZLES, as shown on this diesel "blower", are also used to inject Chevron Starting Fluid into intake manifolds of gasoline engines. Complete primer equipment may be purchased from your fluid supplier. Chevron Starting Fluid comes in 3-pint cans, and capsules of two sizes—7CC's and 17CC's, packed 12 and 24 per can. It is approved by leading engine manufacturers.

How CHEVRON Starting Fluid Starts Gasoline and Diesel Engines Instantly



A. Atomizes in lowest temperatures and provides powerful, easily fired vapor in combustion chamber.

B. Pressure, or the weakest spark, fires mixture—turns engine and heats air for regular fuel mixture.

C. Contains lubricant and additives—prevent cylinder wear and ice formation in primer equipment.

HOT NEWS COLD ENGINES

FREE BOOKLET gives you more facts on Chevron Starting Fluid—shows where it should be applied in different type engines. Write or ask for it today.

CHEVRON STARTING FLUID

TRADEMARK REG. U.S. PAT. OFF.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

STANDARD OIL COMPANY OF CALIFORNIA • San Francisco
THE CALIFORNIA OIL COMPANY • Barber, N.J., Chicago, New Orleans
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colorado

What *important* thing

to change THIS

was necessary

to THIS

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*The Cook 124 features a special pressure-energizing, anti-flutter design and is made of a proven wear-resisting material—Cook Graphitic Iron.

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and DIESEL TRANSPORTATION

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Season's Greetings

Contents

Cover Photo:

Align boring bearing saddles in a locomotive engine frame. Work is being done in an Atchison, Topeka & Santa Fe shop.

EDITORIAL

Today's Maintenance Picture 35

ARTICLES

Heavy Engine Overhaul 38
Safeguarding Parts During Shipment and Storage 43
Common Abuses of Injection Equipment and Corrective Practices 44
On-the-Spot Lube Oil Evaluation 48
Recognizing the Causes of Valve Failure 52
Chemical Descaling Simplifies Block Rebuilding 58
Crankshaft Regrinding 62
Tractors Thrive with Proper Maintenance 66
Shop Repair and Reconditioning of Storage Batteries 68
Special Tooling Helps Production 72
Special Tools Help Maintenance Programs 74

FEATURES

Highlights 37
New Products 78
Field Notes 88
Advertisers' Index 98

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Editorial:

Today's Maintenance Picture

THERE was a time in the history of the diesel engine when the engine builders not only produced an engine but played a prominent role in its maintenance and repair. The type and comparatively small number of engines in operation permitted this direct paternal attitude.

There were two good reasons for this situation. First, outside facilities and "know-how" were not generally available and the builder was in the best position to do the job properly. Next, the practice was encouraged as this repair work, involving parts, was a much needed source of income.

Unfortunately, efforts to retain as much of this business as possible discouraged any free flow of information concerning the engines their maintenance and repair. The result was to create an air of "mystery" about diesels that persists in some minds even today.

Changing times and conditions have necessarily altered the situation. The ever increasing number of engines scattered over the international scene requires a decentralization of facilities for service and repair — not forgetting parts supply. The engine builder still retains the responsibility for providing the necessary spare parts and, on the basis of engineering skill and experience, is still the best source of advice and guidance on problems that are bound to arise.

Their natural interest and concern for the reputation of their product is an incentive to render every possible assistance to the user. Yet each has been faced with the problem of rendering widespread service and each has reached a solution in accordance with his particular type of engine, its application and his philosophy on the subject.

Builders of larger engines have done a very creditable job by having representatives and stocks of parts located in various strategic locations. Those building the smaller types, due to the numbers involved and variety of operation, have been forced into a more elaborate network of localized service points frequently involving distributorships and dealers. Whatever the system, it must provide service in accord with customer needs.

Supplementing the facilities offered by the engine builders and their representatives we now find a rapidly growing second line of defense in the fight against downtime. There have always been a few fine machine shops specializing in diesel repair but the number is expanding rapidly.

Included are shops doing complete overhauls and many that specialize in a certain type of repair, for example, crankshaft regrinding. In each case, the service springs up to fill a particular need in a particular area.

In discussing the overall service facility picture, the shops of user organizations cannot be overlooked. Bus and truck fleet operators, contractors, the railroads, to cite a few categories, are performing their own work.

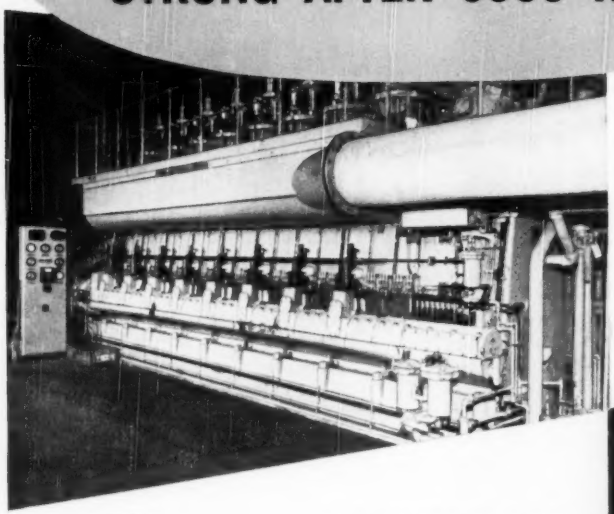
In contrast to earlier attitudes, most engine builders are alert to the fact that they can no longer directly control maintenance and in their own interest must "open up" so that this outside work is done properly. Much more information on design, operation and maintenance is now available than at any previous time.

Expansion of the repair facilities, no matter what the type, has also created a substantial market for the tool industry. Standard machine tools are, of course, a necessity as are hand and precision tools. There has also been an incentive to develop special tooling or to adapt existing designs, used commonly in the automotive field, for diesel application. Where necessary, such tools as align boring bars, crankshaft regrinders, ridge reamers, cylinder hones, valve facing and seating equipment, etc., have been increased in capacity to meet diesel needs.

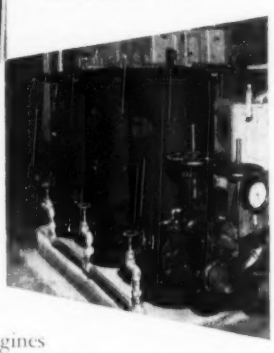
Today, there is no justification for poor maintenance. Information is being disseminated with greater freedom than ever before; a network of maintenance facilities that is currently in being includes the engine builders and their representatives, user shops, independent engine rebuilders and specialized shops; and finally, the tool industry is providing means for doing the work faster, better and cheaper.

All in all, it is a big industry that is still growing. This rounding out of the whole picture on a good, stable basis is an unfailing sign of maturity within the industry.

WINSLOW ELEMENTS STILL GOING STRONG AFTER 6500 HOURS!



One of the two 2160-HP Nordberg engines that supply power for both industrial and domestic use serving the city of Tucumcari, New Mexico.



Winslow Lube Oil Conditioner Models 57-931-A in operation at the Tucumcari Municipal Light and Power Plant.

Winslow Full-Flow Filters on the two big Nordberg engines which supply power for the city of Tucumcari, New Mexico, give full protection to lubricants and help keep these powerful diesels running with maximum efficiency. "We have had one filter in use about eleven months with about 6500 engine hours run without replacement of filter elements," states J. D. Armstrong, Manager of the Tucumcari Light and Power Department. "The oil is still in perfect condition. I think Winslow Filters are the finest on the market today."

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+ HIGHLIGHTS +

● The Baldwin Locomotive Works has received orders from the Southern Pacific for 40 diesel locomotives.

● Greyhound Corporation and General Motors have completed arrangements for an order for 761 diesel-powered buses.

● Net profit of Federal Mogul Corporation for the first nine months of this year was $1,974,907, an increase of $430,032 over the same period last year.

● The Board of Directors of the Baldwin Locomotive Works has declared a quarterly dividend of fifteen cents per share on the Company's common stock.

● United States Hoffman Machinery Corp. and subsidiaries net for the first three quarters of this year was $254,099 compared to a loss of $460,909 last year.

● The Air Force expedites the big ones with a new diesel tractor with double-end controls capable of running sideways and towing a 400,000 lb. aircraft.

● National Bureau of Standards reports the development of apparatus for determining rate of response of jet-engine temperature elements under conditions closely approximating those in the combustion stream.

● It is now reported that bull moose, mistaking the sound of diesel locomotive horns for a mating call, are attempting to get better acquainted with the diesel locomotives in Canada. The bulls stand in the path of the locomotives with fatal results.

● Socony - Vacuum president B. Brewster Jennings, speaking before a meeting of the Texas Mid-Continent Oil & Gas Association in Dallas, said recently that "For our country as a whole, we estimate oil and natural gas this year will supply 59 per cent of our energy requirements, compared with 44 per cent in 1940."

● Caterpillar's earnings for the first nine months this year were $25,412,997 net, almost double last year's figure for the same period.

● An order for three diesel rail cars has been received from the Commonwealth Railways of Australia by the Budd Company.

● Westinghouse reports that its third quarter net sales billed, bookings and net income were the highest in the company's history.

● Central Greyhound has announced that it will purchase 111 new buses from GMC at a cost of $300,000. First deliveries are expected early next year.

● A sufficient number of creditors have voted in favor of a re-organization plan for the Sterling Engine Company to put it into effect. It is expected that the firm will soon be in production on diesel engines.

● Rights in Germany for the use of the Al-Fin process of molecularly bonding aluminum to ferrous metals have been granted to Metallgesellschaft, A.G., of Frankfurt, Germany, by the Fairchild Engine and Airplane Co.

● According to Gwilym A. Price, president of Westinghouse, orders for generating equipment in the first three quarters of 1950 were three times that of the 1949 total indicating that the utility industry was anticipating future power requirements in this period of global defence.

● An electric governor under development by the Navy Engineering Experiment Station reacts on any change in load current. Tests indicate an ability to restore engine speed and frequency of small quantity plants to within 0.5 per cent within ½ sec. after change from zero to full load. Steady load speed is held within ¼ of 1 per cent.

● In the first six months of this year, the cost of diesel fuel has dropped an average of 9.2 per cent.

● The New York Central has ordered 27 diesel switchers from the Lima-Hamilton Corp. The order covers an expenditure of $2,400,000.

● Worthington Pump and Machinery profits for the first nine months of this year were $3,951,245 net compared to $3,997,399 net for the same period last year.

● The Erie Railroad will spend a million dollars in Marion, Ohio, and a half-million in Hornell, N. Y., to expand their diesel facilities in these two towns.

● Houdaille-Hershey Corporation profits for the first nine months of this year were $2,429,040 net, compared to $2,024,377 for the same period last year.

● Canadian Car and Foundry Co. has received an order for thirty 36-passenger Canadian Car-Brill diesel buses from the Quebec Railway, Light and Power Co.

● The Chicago, Milwaukee, St. Paul & Pacific RR has asked the ICC for authority to issue $5,430,000 equipment trust certificates, proceeds of which will be used to buy 34 diesel locomotives.

● The New York Central recently placed an order for 200 diesel engines which will cost $31,000,000. This is the largest order ever placed by the Central and will give the road 1255 locomotives when delivery is completed.

● According to Mr. Bransome, president of Mack, there are over 8,000,000 trucks in use of which 27 per cent are owned by farmers and 56 per cent owned by establishments carrying their own goods. Federal, state and local governments account for 335,000 and of the 1,000,000 for-hire trucks, 10 per cent are operated by the railroads.

Railroads increase emphasis on—

Heavy Engine Overhaul

*by W. L. Huebner**

AS MORE railroads switch from steam to diesel motive power, the railroads are giving increased attention to the maintenance, overhaul and repair of diesel engines. Diesel facilities are being expanded, shops converted from steam to diesel, and new diesel servicing and repair facilities are being set up along the railroad routes.

Railroad diesel maintenance shops now number almost 300 on the various lines in the country and many roads are now expanding their shops. (*The Erie recently announced it will spend 1½ million dollars to enlarge its diesel facilities at Marion, Ohio and Hornell, N. Y. Ed.*)

With these facilities, the railroads are studying the problems of maintenance and repair to increase efficiency in the diesel shops. Much attention has been given to maintenance and overhaul schedules. Various systems are being used by the railroads. Some are based on mileage, others on fuel consumption, hours of operation or calendar periods. The Santa Fe bases its overhaul schedules on crankshaft wear limits as set by the manufacturer or when other major defects develop.

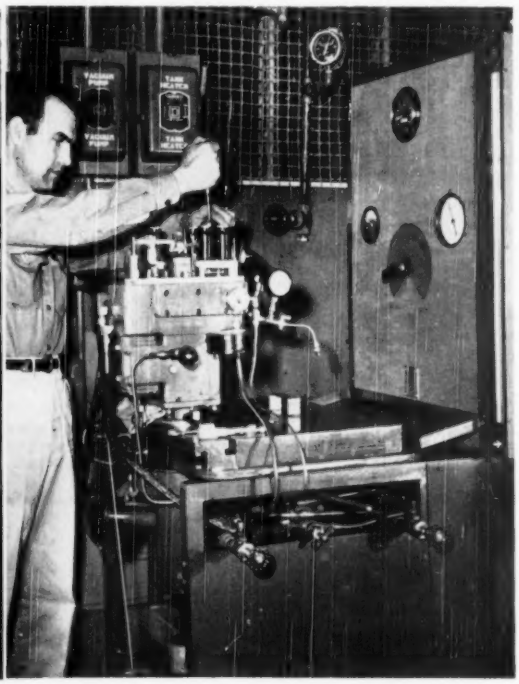
The manufacturers have continued to improve the diesel engine. Advanced lubricating oil systems, changes in engine designs and the use of better steels and alloys which were developed, particularly, during the last war have contributed to the improvement. With all these advances, we should be able to operate the latest types of diesel engines a longer period of time before heavy engine overhaul becomes necessary.

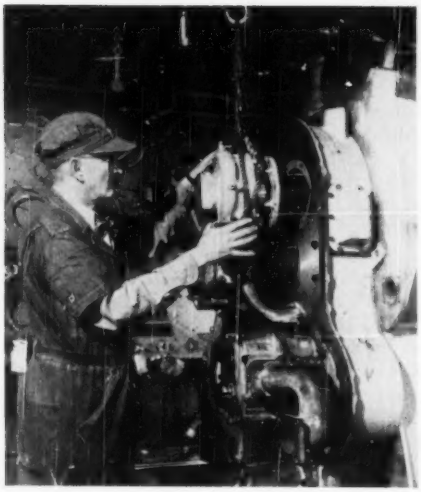
This subject can best be covered by considering the individual parts of the engine and giving the recommended procedure of overhaul that is now followed throughout the country. The various engine parts that will need attention are:

1. Crankcases
2. Crankshafts
3. Camshafts
4. Connecting Rods
5. Main and Connecting Rod Bearings
6. Cylinder Heads
7. Pistons
8. Liners
9. Gear Trains
10. Timing Chains
11. Blowers
12. Superchargers
13. Governors
14. Lubricating Oil Pumps
15. Water Pumps
16. Fuel Injectors and Nozzles
17. Fuel Injection Pumps

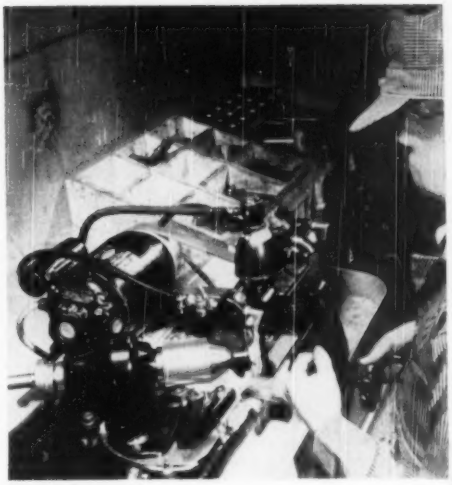
Machinist grinding valve seats in diesel cylinder head. Stone sleeve on pilot in guide bore properly positions stone for seat grinding.

Diesel governor being adjusted by machinist in Santa Fe shops at Barstow, Cal. The testing machine was devised by machinists in the shop.





(left) After heavy engine overhaul, the mechanic puts a water pump on the diesel engine.



(right) Exhaust valve seats are faced during overhaul. Special rig insures that correct seat angle is obtained.

Crankcases

On some diesel engines the crankshaft and bearing supports are located in the section known as the oil pan. On others, they are located in the crankcases. I am going to treat both of these as one.

At heavy engine overhaul periods the crankcases should be thoroughly cleaned and carefully inspected for cracks and other defects to determine what repairs will be required. The crankcases can be cleaned with a spray gun and solvent. If the engine has been removed, the crankcase can be submerged in a vat of caustic solution to remove all the old paint, grease, oil and sludge. The caustic solution must be removed by thoroughly washing the crankcase with steam and hot water and blown dry with compressed air.

If a crack is found in a cast crankcase, the crankcase will have to be replaced. At the present time no satisfactory means of making permanent repairs has been found. It is not possible to weld the cracks.

When cracks are found in steel-fabricated crankcases, they can be repaired by welding a patch over the crack. Cracks in cylinder head retainers have no detrimental effect on the engines, if they are located and properly checked before they reach the cylinder head seats or water passages. Cracks in the lower six inches of the retainer can be contained by drilling a $\frac{5}{8}$ in. hole through the retainer 3/16 in. beyond the edge of the crack, in line with the crack, to stop further progress.

Serious failures can be avoided if small cracks in crankcases are detected by magnafluxing and properly welded at heavy engine overhaul periods. Extreme care should be taken in the preparation and welding of the cracks to avoid distortion through weld deposit shrinkage and excessive heating.

When welding cracks in crankcases and oil pans, it is a good practice to drill a $\frac{1}{4}$ in. diameter hole $\frac{1}{2}$ in. beyond each end of the crack to stop further progress of the crack during preparation and welding. In the process of welding, each weld bead should be peened while hot to partially stress relieve and should be inspected to make sure all traces of the original crack have been eliminated. Allow ample time for each weld bead to cool.

When cylinder bores have been damaged, they can be built up by electric welding and machined to bring them back to their original dimensions. If pitting is found in the cylinder head retainer bores, these can be machined and stainless steel insert rings applied. Some roads prefer electric weld and machining for the cylinder head bore in preference to the stainless steel ring. However, use of the stainless steel ring has been very successful on the Santa Fe.

When the diesel engines have been removed from the locomotive for heavy engine overhaul and dismantled, the main bearing supports, bearing caps and studs should be inspected. The main bearing caps should be applied and tightened and the main bearing supports checked for alignment and out-of-round limits.

When the out-of-round limit of 0.002 in. on the main bearing bore is found on any support or "A" frame, the bearing supports must be line bored. The crankcase or oil pan may be returned to the engine builder for this work or it may be done in your own shop. In the past few years a number of railroads have been line boring their crankcases and oil pans without difficulty with machines they have designed and built.

The crankcases and oil pans of the diesel engines should last for years if they are properly maintained and repaired at time of heavy engine overhaul and should only require replacements when destroyed or damaged through accident or breakage within the engine.

Crankshafts

Whenever crankshafts are removed from the engine they should be magnafluxed and carefully inspected for

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Supervisor of Diesel Engines, A. T. & S. F. Railway system, Chicago. Abstracted from a paper presented at an Annual Meeting of the Locomotive Maintenance Officers' Association in Chicago.

cracks and all journals measured for wear. If the crankshaft journals have reached the wear limits, as set up by the engine builders, it will be necessary to recondition the crankshaft. The most desirable method at the present time is to grind the journals to an undersize diameter. To do this, the crankshaft must be sent either to the original manufacturer or to shops where special machinery has been set up for doing this work. A notation that a journal has been ground undersize should be attached to the engine to guide personnel making repairs at some future date.

In cases where bearing failures or breakage within the engine has caused an individual pin to be scored and all the remaining pins and journals are in good condition, the scored pin can be ground to a standard undersize without removing the crankshaft from the engine. To avoid future difficulties with this undersize pin, a notation that it is undersize should be attached to the locomotive maintenance sheet.

At the present time, tests are being conducted on chrome plating of worn journals and grinding them to their original dimensions. Tests are also being made on the repairing of damaged journals by a sleeving process.

Camshafts

Inspect camshafts whenever possible. Magnaflux the shaft and measure the journals for wear whenever they are removed from the engine. When the journals have reached the wear limits or other defects found, replace the shaft or, if it is a built up type, replace the worn section.

Rods have to be replaced whether or not the cams have been damaged. No practical way has yet been found to replace only the cams when they are damaged.

Connecting Rods

Connecting rods should be cleaned, magnafluxed for cracks and inspected for damage whenever they are removed from the engine. The basket or cap should be applied to the connecting rod and the bore measured for wear and out-of-roundness. On diesel engines which use the blade rods, the bearing fit should be checked on a mandrel. All connecting rods should be checked for parallelism and any rod found bent should not be re-used in the engine. The connecting rod eye should be measured for out-of-roundness and wear limits.

The inspection of the connecting rods will be made at the time of piston inspections and removed when any defects are found.

Main and Connecting Rod Bearings

Whenever main and connecting rod bearings are removed from the engine they should be cleaned and examined for shelling, pitting, wear and evidence of working in the bore. It is a good practice to measure the wall thickness of all main and connecting rod bearings each time they are removed for inspection. The connecting rod bearings should be applied in the rods to check the bearing fits in the bore and measured for out-of-roundness.

When bearings are removed for shelling, pitting, wear or any other defects, they should be scrapped. Some tests have been made on relining the bearings but this has not proven satisfactory up to this time.

It is the practice on the Santa Fe to remove and inspect all main and connecting rod bearings when any bearing material is found in the crankcase or on the lubricating oil filters; defects are indicated; lubricating oil becomes diluted with fuel oil or contaminated with water; or when any engine is reported or found to have low lubricating oil pressure.

Cylinder Heads

Cylinder heads should be thoroughly cleaned when removed from the diesel engine and inspected for cracks and damaged seal surfaces. The repair of cylinder heads is a generally accepted procedure which amounts to regrinding valve seats, applying new valve guides and testing the water space for leaks.

In grinding the valve seats it is recommended that a high speed grinder be used and that all valve seats be kept within the manufacturer's standards.

Cracks which have developed in cylinder heads have been successfully welded and remachined to manufacturer's specifications. The repaired heads have operated for considerable mileage without any difficulty. A repetition of welding on the same cylinder head is not advisable and the general practice of welding cylinder heads is not being used by many of the railroads.

Cylinder heads should be overhauled when removed at time of piston inspections or when any defects occur.

Pistons

When pistons are removed for mileage or any defects, they should be thoroughly cleaned and inspected for cracks, scuffing and scoring. The carbon deposits must be cleaned out of the ring grooves and oil drain holes and along the face of the ring lands and off the piston crown.

The piston should be measured for wear and kept within the limits as set up by the manufacturers. New rings should be used at each installation of the pistons to ensure quick seating and eliminate ring difficulties.

The clearance of the rings in the ring grooves should be checked and if they exceed the wear limits as specified, the grooves should be refinished and over-width rings installed. The machining for over-width rings applies particularly to aluminum pistons. Some roads have successfully reconditioned aluminum pistons by cutting away the worn ring lands, then applying new metal, and finally remachining to original dimensions.

When cracks develop in the crown of the large aluminum pistons, they can be shipped out and welded either by electric or acetylene process if care is taken to hold the distortion to a minimum. A number of railroads have used this system for the past few years and very satisfactory results have been obtained.

Pistons should be removed from the engines when any defects occur. These defects are usually cracks, broken rings, ring blowby, excessive piston to head clearance, broken lands, and scuffing or scoring.

The service life of pistons at the present time is considerably greater than a few years ago and it is now possible to safely operate pistons up to 750,000 miles in freight service without any difficulty. However, they should not be in service longer than two years without being removed for inspection.

Cylinder Liners

Cylinder liners should be inspected for scale in the water jacket, thoroughly cleaned and reconditioned each time they are removed from the engine.

The cylinder liners should be checked for scoring and other defects, water tested for cracks and leakage at the plugs and liner studs, magnafluxed, and measured for wear. All liners should have the ridges at the top of the ring travel removed and cylinder liners which are not chrome plated should be honed to remove the glaze from the cylinder wall.

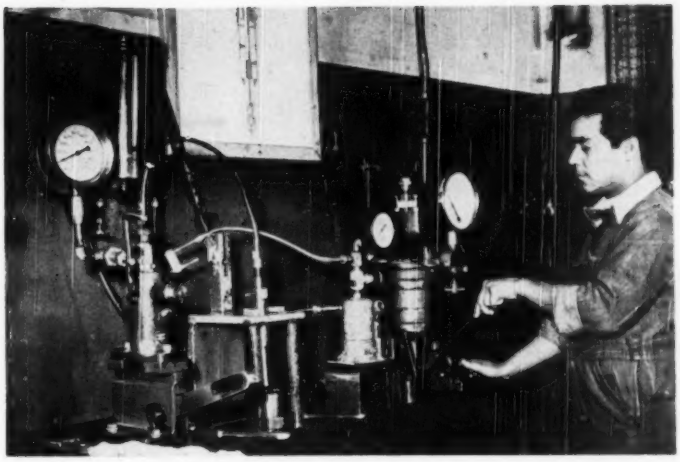
When cylinder liners have reached their limits of wear, they can be refinished to the next oversize or can be brought back to their original dimensions by a type of porous-chrome plating. The cylinder liners can be returned to the manufacturer for reboring or this can be done by the railroads in their own shops. The process of porous-chrome plating of the cylinder liners should be done by a specialist in this work.

Gear Trains

The gears, bushings, stub shafts and all parts of the gear train and accessory drive gears should be thoroughly cleaned and inspected for cracks and measured for wear each time they are removed from the diesel engine.

When defects are found or the wear limits are reached, the parts should be renewed. Some tests are being conducted by the Burlington in the use of reground stubshafts and undersize bushings on EMD 537 engines and I understand the results have been quite successful.

It is a good practice to check the valve timing at each annual inspection and examine the gear train if the exhaust valve timing is getting late.



Machinist testing Fairbanks fuel nozzle. Buda test rack for EMD engines can be seen in center and tester on left is testing nozzle for Alco engine.

Timing Chains

Timing chains should be inspected periodically for wear and tension adjustment. When timing chains have been removed at heavy engine overhaul periods they should be thoroughly cleaned and inspected for wear and other defects.

No mileage inspection has been set up on timing chains, but they may be continued in service if no defects exist until the full range of the idler sprocket has been utilized. When the timing chain slack can no longer be taken up, a new chain must be installed or serious damage will result.

Blowers

When blower bearings become worn enough for rotor interference, aluminum dust will appear in the support housing and in the air box. An oil leak at the blower oil seal will also show an excessive amount of oil at these locations. The blowers should be removed and overhauled when these conditions are found or other defects exist.

Blowers should be removed and overhauled at time of heavy engine overhaul. Whenever blowers are removed from the diesel engines they should be carefully inspected and the oil seals tested for leakage.

Blowers may be returned to the manufacturer for repairs or they can be satisfactorily repaired in your own shops if the specifications and tolerances set up by the manufacturers are closely followed.

Superchargers

Superchargers used on the Buchi system of turbo-charging should have the bearings removed and inspected on each semi-annual inspection of diesel engines in all types of service.

The superchargers should be removed and overhauled when defects occur, abnormal vibration is found, and the length of the free running period of the supercharger rotors is not within the manufacturer's specifications. Superchargers should be removed and overhauled on each annual inspection on diesel engines in road service and on three year annual inspections in switching service.

The superchargers used on other types of turbo-charging systems should be removed and overhauled on each annual inspection in all types of service or when defects are indicated.

When superchargers are overhauled the specifications and tolerances set up by the manufacturers should be followed and after they are completely assembled they should be tested for speed, temperatures and pressures.

Governors

The governor should be removed, dismantled, cleaned and inspected on diesel engines in all types of service

on two year annual inspections and should be overhauled at time of heavy engine overhaul or when removed because of defects.

We have found that diesel engine governor faults in practically all cases are caused by dirt within the governor. They can be cleaned and completely overhauled in our own shops with the proper tools and test equipment.

Lubricating Oil Pumps

Lubricating oil pumps should be dismantled and overhauled when removed from the diesel engines when defects are indicated, at time of accessory drive inspections and at heavy engine overhaul periods.

When lubricating oil pumps are dismantled, all parts should be thoroughly cleaned and checked for wear and other defects. All dimensions and clearances must be kept within the limits set up by the manufacturers.

When the overhaul of the lubricating oil pumps has been completed, it is a good practice to check the displacement of the pump to see that it is within the manufacturer's specifications.

Water Pumps

Water pumps should be overhauled whenever they are removed from the diesel engine for defects or other engine work.

When the water pumps are dismantled, the drive gears and ball bearings should be carefully inspected and all parts should be cleaned and measured for wear and inspected for defects.

Fuel Injectors and Nozzles

When fuel injectors are removed from the diesel engines for defects or other engine work, they should be tested to see if the nozzle valves are seating properly, the opening pressure and pressure drop are within the safe limits.

If the injectors are not within the safe limits or are removed for defects they should be overhauled.

Fuel injector nozzles should be removed on each quarterly inspection and the opening pressure of the nozzle valve checked and the nozzle tested. If the nozzle does not function properly

Machinist assembling piston and connecting rod after annual inspection and overhaul.

or has been removed for any defects a new or overhauled nozzle tip should be applied and the tip removed should be overhauled.

The fuel injectors and nozzles can be overhauled in your own shops, if special tools are purchased and the proper dustproof facilities are set up.

Fuel Injection Pumps

The fuel injection pumps should be changed on diesel engines in road service on annual inspections and on two year annual inspections on diesel engines in switching service or when any defects are indicated.

We have found that considerable special equipment is required in the overhaul and testing of fuel injection pumps and it is not economical to make our own repairs.

Summary

When the diesel engines are being assembled, the nuts on the crab studs, cylinder liner studs, main bearing and connecting rod caps and basket cap screws should be tightened with a torque wrench to the figures recommended by the engine builders.

After the heavy engine overhaul has been completed, the diesel engines should be properly load-tested to correct any water, fuel oil, or lubricating oil leaks, to see that the bearings operate at the proper temperatures, and to properly break in the diesel engine.

On the Santa Fe Railroad, we give the diesel engine a full four hour load test at full load after heavy engine overhaul periods. When difficulties are experienced with engines losing water, low lubricating oil pressure, improper loading and at the completion of annual inspections, the engine is load tested in order to determine its exact condition.

After the load tests are completed, the compression clearances of all cylinders on two-cycle engines are checked and recorded, the main bearing cap nuts, connecting rod nuts or basket cap screws are retightened to the torque wrench figures. The rocker arms are removed and all cylinder liner nuts and crab stud nuts are also retightened to the torque figures. All external nuts and cap screws on the diesel engine are retightened and all final adjustments and inspections are made at this time. The diesel engine is then ready for service.

After the diesel engine is in service and comes into the routine maintenance terminal for its first work, which is 3500 miles in freight service, 4500 to 6000 miles in passenger service, and on the first monthly inspection for switching service, the rocker arms are again removed and the cylinder liner nuts, crab stud nuts, connecting rod cap nuts or basket cap screws are again retightened with a torque wrench to the figures recommended by the engine builders. When any cylinder assembly is changed out, we follow this procedure of retightening the assembly on the first work after the application.

On our routine maintenance inspections, compression clearances on all cylinders of the two-cycle engine are taken and recorded at time of monthly inspection and the cylinder liner nuts and crab stud nuts are checked to the torque figures.

Strict routine maintenance schedules, basing of heavy engine overhaul period on the wear of the crankshaft journals and defects in the crankcases, following the engine builders' specifications and proper inspections and load testing of the diesel engines have greatly contributed to our success in economical operation of the diesel locomotives in all types of service.

Safeguarding Parts During Shipment and Storage

A bulwark of any maintenance and repair program is the stock room. The right parts in the right quantity—and in good condition—are a necessity if work is to be done expeditiously. Whole volumes could be written on the subject of parts scheduling, storage procedures, etc., and then the basic principles would have to be tailor-made to fit each individual case.

There is one common factor: all stocking operations are a form of overhead. If all factors are not controlled, it can seriously eat into profits. One particular phase is the subject for this discussion—adequate protection of parts in the process of handling and storage.

Parts protection during handling should start with the engine builder. To show the extent of consideration devoted to this matter two outstanding examples are given. In fact, these were good enough to win two first prizes in six packaging classifications and "honorable mention" for the second best "inner pack" in a recent competition conducted by the Society of Industrial Packaging and Materials Handling Engineers.

C. L. Foy, in charge of package design at Detroit Diesel submitted three entries, two of which, a Fuel Injector Package and Cylinder Kit Package, were the winning entries.

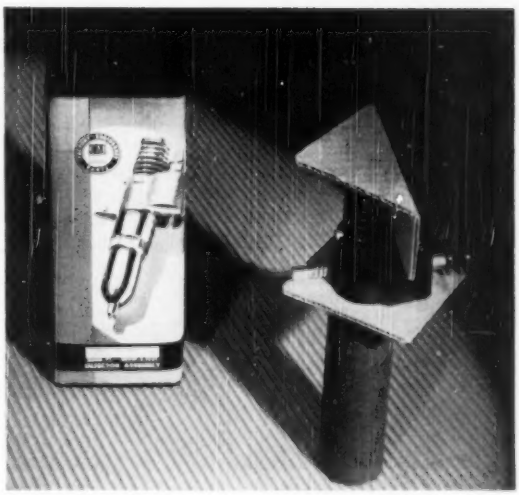
The first of these was designed to protect the spray tip with its minute orifices, the rack, and the plunger spring. Other considerations were protection against oil drainage, reusability of the container for overhauled units and attractiveness to aid in merchandising. Dirt proofing and additional strength for protection of the unit are major features. The cylinder kit package was designed with similar objectives.

Both of these packages show definite advantages, not only to the manufacturer but to the user. Cost reductions, 18.5 and 14.5 per cent respectively, reduce the manufacturer's overhead while giving increased service to the customer. The annoyance and cost of damage complaints has been reduced for both.

Users gain additional benefits in that they are assured serviceable parts, adequately protected in the event of long storage, and accruing advantages through reductions in cubage and weight. These factors are extremely important in stockroom operation.

This example serves to show the many advantages derived through attention to the details involved in proper parts handling and storage.

New cylinder kit package which won prize in recent competition. Note box for rings in center of corrugated board pack.

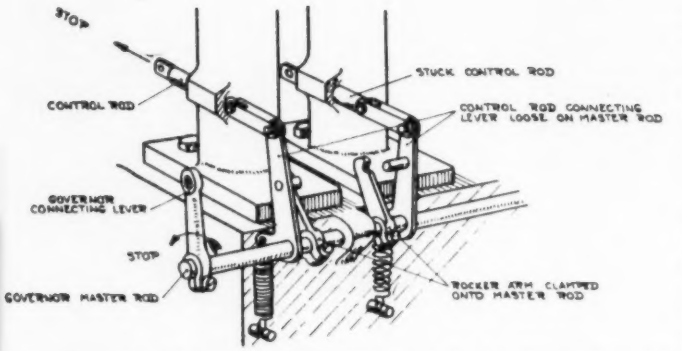


Injector kit package. Cardboard protects vital injector parts from damage during shipment and storage.

Common Abuses of

Injection Equipment

and Corrective Procedures



Typical arrangement of a protective feature to minimize effects of rack sticking. Should one rack stick, balance operate normally under governor control permitting the engine to be shut down.

Everyone has some specialty and frequently it is hard to see why others fail to get your own particular slant on things. To illustrate this point, let's take a man well versed and possibly representing a builder of fuel injection equipment. He literally has the "horrors" when he sees some of the practices commonly occurring in the field.

The answer is obvious; the other fellow may be a specialist in some other line and simply does not know the correct procedures as it may be new to him. This is a matter for education to build up an appreciation of the capabilities and limitations of the equipment as well as the fundamentals of good maintenance practices.

Let's take a trip through an imaginary railroad shop and point out some of the more common abuses so readily apparent to our specialist in injection equipment. No one shop could do so many things wrong and thus our mythical shop embodies all the worst practices to be found in the field.

Cleanliness

One of the first things that will offend our specialist is the general carelessness with regard to dirt. Naturally, since he is used to the air conditioned spotlessness of the manufacturing plant. These conditions cannot be maintained in the field and, in fact, are not necessary when the system is closed up and in operation.

External dirt is to be avoided wherever possible but the designers have considered this and dirt does not assume its true significance until the system is opened.

But wait, what is that fellow doing,

"Watch the injector's expression when they hook me up and he gets this slug of dirt."

oiling the pump racks? Oh no, not again! Those shiny racks seem to have a fatal attraction for anyone with an oil can. And usually the can will be full of a high viscosity oil. What's wrong with oiling the racks? Well, let's see.

The sole purpose of the racks is to turn the plungers in the barrel so as to alter the portion of the metering helix indexing with the ports. This requires little effort and the power output of the governor power piston is predicated on the normal load with a reasonable safety factor. Concentricity and fit of the parts moved by the rack are held to close tolerances so that if the pump is held on its side, the weight of the rack is sufficient to turn them as the rack moves downward.

A heavy coating of viscous oil will increase the frictional load and this will be aggravated in cold weather or when concentrations of dust and dirt accumulate on the oiled surface. Another little item that will not help matters any is the lint and threads from waste used around the pumps for cleaning. Better use rags to be safe. In short, rack movement will be sluggish from an accumulation of causes with the result that the sensitivity of governor action will suffer or, in extreme cases, the rack will stick. So, please, see that there is only sufficient light oil on the racks to keep them lubricated and protect them from rusting.

Hey, just a minute; don't lay those high pressure injection lines on that grimy side panel. That is a really good way to get dirt into the nozzles. Even if they are washed (and they may not be) dirt is pretty tenacious stuff and some might remain to ruin the injection nozzle that the injector

shop boys just sweated over. Why not eliminate the dirt at the source and play safe? Provide a clean place for storing the lines until they are reinstalled. Also protect them from airborne dirt such as soot and fly ash.

Now take a look at those hands, tools and clothes. In handling the injection equipment it is entirely possible that dirt from these sources may be forced into the open passages. Sure, roundhouses are dirty and some of the jobs on diesels equally so, but concepts of cleanliness are changing with the advent of diesels and new, clean, efficient shops are being built. Why not follow the trend and make a practice of cleanliness? It is one of the principal tenets in getting the most out of injection equipment.

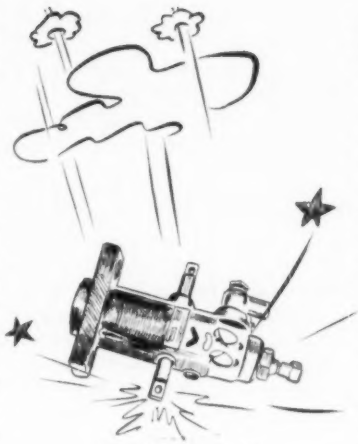
Handling

We see that some injection pumps have been removed from engines and are being shipped to the factory for overhaul and calibration. It is a rush job and a car is being loaded for the trip to the plant. The pumps are being brought out and thrown—thrown, mind you—into the trunk of the car. Now, what is wrong with this picture?

It can be summed up as carelessness in handling. The housings are rugged and can take it but remember what has been said about the racks. This is a very efficient way of bending them; then they bind and must be replaced. Look, some of the pumps lack shipping caps or other covers over the openings with the result that dirt can enter.

You may say that the pumps are due for overhaul so what difference does it make. True enough, but during the process of dismantling, the pumps will undoubtedly be operated if only to compress the plunger return springs. Besides, how many times have you seen someone pick up pumps and hand operate them out of idle curiosity? Damage to the plunger, barrel or delivery valve may occur if dirt is present and what was simply a routine overhaul and calibration will turn out to be a matter of major parts replacement.

This same idea of preventing the entry of dirt should be carried out



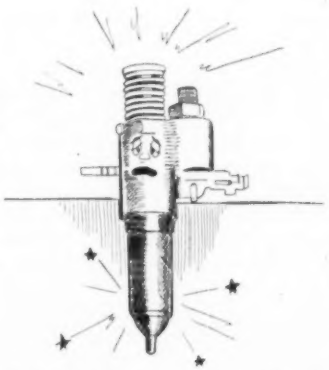
"Oh! My aching rack."

throughout the entire shop. When removed from the engine, pumps should be handled carefully, placed in a clean spot and then transported and stored in the same manner. On the return trip the same principles should be observed.

These and previous comments apply equally well to the nozzle holder assemblies. In fact, the precepts mentioned regarding cleanliness and handling apply to every item of the injection system. They also apply broadly to the storage, handling and use of fuel.

Installation

Let's watch this fellow changing a set of injectors. This is a job that occurs with comparative frequency and



"Ouch, you're cramping my figure—I'll never be able to move."

should be well understood. The injectors came out alright but he had to look around for a clean place to put them. Now for installing the new set.

Hey, wait! How about cleaning that cavity before installing the new injector? Combustion gases leaking around the sides of the spray tip cause carbon deposits to form and these may interfere with the seating of the replacement unit. Reamers and scrapers are available for cleaning up the hole and should be used. For best results the injector should be a free fit resting on the gasketed seat.

That brings up another point. New copper gaskets should be used. Chances are that previous tightening of the hold-down bolts or clamps has compressed the gasket to the point where it fits tightly against the sides of the bore. This is one reason why trouble is often encountered in removing them. If compressed again there is only one way that the copper can expand and that is against the side of the nozzle assembly.

Believe it or not, this pressure can be sufficient to cause the needle of the nozzle to seize in its bore. Remember that the fit is very close and that only microscopic distortion of the metal is required to eliminate this clearance.

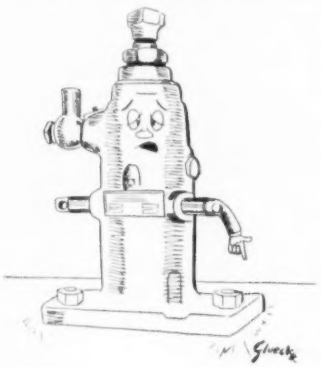
This subject warrants some discussion since it is so hard for some to realize that it actually does occur. Distortion from pressure is a common occurrence but frequently this fact is overlooked because it makes little difference. All are familiar with the emphasis placed on proper torqueing and sequence of tightening when installing cylinder heads in the automotive field. If the strength of bolts or studs was the only consideration, stronger materials or larger sizes could be used. The prime reason is distortion. It has been found for example, that valve seats can be distorted by dimensions measured in thousandths of an inch. Frequently, the metal around studs will be pulled up to the point where, to insure good gasket seating, the block must be resurfaced. As another example, it has been found that the gap between the electrodes of spark plugs will vary as much as 0.005 in. when installed with different degrees of tightness.

If such distortion can occur in masses such as an engine block, imagine how easy it is to cause the seizure of a closely fitted needle in its bore. The answer is to torque the fastening devices to the recommended tension, use new gaskets and see that the injector cavity and seat are clean and the injector fit proper. These comments apply generally to the unit type of injector as well as to the nozzle holder assemblies used with the individual type pumps.

Now let's watch the installation of those replacement pumps. Timing is adjusted by shims under the pump flange in this particular case and we will want to watch it closely. Just a minute, let's watch the windows in the pump housings to be sure that some plunger is not jammed against the delivery valve. It is possible that someone removed the original shims and that the cam could be at its highest lift. It would be better to bar over the engine to be sure that the tappets were riding on the base circles of the cams. That way the timing mark should be in sight at the bottom of the window.

No, you can't take the timing for granted. Not only will pumps vary slightly but maybe timing is one reason that that baby ran a little rough before you went to work on it. Better be sure; timing can make or break — and we mean break—an engine. Bar the engine into the proper position and check the timing mark on the guide cup with the one on the housing window. Yes, each one. By the way, when you are spotting that flywheel be sure that you bar the engine in the direction of rotation. If you go past the mark, back up a considerable distance and sneak up on it again. In this way you will always have the backlash in the timing train taken up in the same direction as the engine will run. Now, check the timing by lining up the marks on the pump housing. On this engine you use shims but on others there may be adjustable tappets. That is all you can do until you get the engine running. Then, if it is possible to measure the firing pressures, slight timing adjustments may be required to balance the cylinders. Advancing the timing by raising the plunger will increase maximum cylinder pressures and vice versa.

What is the matter with that pump? Having trouble fitting the pilot below the flange into the bore? It shouldn't be tighter than a snug fit. Better look for trouble and don't start pounding or pulling it down by means of the studs and nuts. The latter is a good way to break the flange and have you ever noted that the edge of a bore makes a fine broach to cut metal under certain conditions? Look for cocking of the pump, burrs, etc. Gentle persuasion should seat it and remember to keep heavy tools away from those



"Hey! they left out my shims. Wait 'til we start, I'm going to blow my top."

racks. It is surprising how easy it is to damage them through carelessness and to cause binding.

That pump looks slightly cocked and the bore looked as if it had been pressing against the pilot on one side. Let's see the shims. Uh huh, someone was careless in peeling the laminations. See how this layer was torn at the narrow part around the pilot bore leaving one side of the shim thicker than the other. Not only will the pump be cocked and the flange warped but you can bet that there will be considerable wear on the tappet and plunger guide cup.

Are you just going to put that rack control linkage back on again without checking it? Look for excessive wear at the joints. Slack in these will cause erratic governor control and make balance among the cylinders impossible to maintain. Check on alignment, too. Frequently, as a result of carelessness, the linkage will be bent or not lined up during installation. Lateral loads not only cause rack wear but add to the load of the governor with resulting lack of sensitivity.

Hold on, why are you fooling with that rack pointer? Don't bend it just because it is hard to see. That is as bad as the fellow we saw that had put spacers under all the pointers to move them out for easier reading. Those pointers are accurately set to show the actual pump delivery volume at the various rack settings when calibrated at the factory or in shops with calibration stands. Besides serving as a reference when hooking up the control linkage they are very handy for checking the load on the engine since delivery in cu. mm. can be quite accurately correlated with engine output.

Injector Repair

Having convinced ourselves that everything is under control in the shop and that most of the practices offending our injection equipment man have received comment let's take a look at the shop where nozzles are repaired.

Well, they have the idea of cleanliness in here. Room, bench, tools, hands and clothes are all spotless. For effective exploitation of these conditions, the general shop should follow suit. The next step is to watch the procedures.

That wire that is being used to clean the orifices seems big. Is it the proper size for the holes? It is important that the holes are not enlarged in the cleaning process since it only need to be slightly oversize before the nozzle must be discarded. Seems like a lot of pressure is being used to force the wire through. Sure, the carbon is hard but the wire won't stand much before buckling and there is always the possibility of doing damage. One answer might be to soak the parts in one of the many available carbon solvents to simplify the job. It will also take off any lacquer or varnish that has formed elsewhere.

Next, we see valve needles being lapped to their seats. That is not a very good idea. Just about the same as grinding engine valves directly on the seats. First of all, in removing deep pits, ridges will be formed and

while the seat may be perfectly all right on test and even work satisfactorily on the engine for a while, chances are that as soon as the parts heat up and expand, the needle will be riding on the ridge. Once leakage starts, the condition gets worse very rapidly.

Here, the answer is to prepare the seat with a lap. Cast iron laps can be obtained commercially and also fine grinding stones, if preferred. The first problem is to obtain the proper angle on the face of the lap. This should match the original seat angle as closely as possible.

Just as in the case of the engine valves previously mentioned it is customary to vary the angle of the valve face and the seat by from ½ to 1 deg. This means that a ring seat will be formed that will widen as wear occurs. This process gives high unit pressure and positive sealing. Since this practice is followed in the factory, it follows that if the original angle is restored it will properly match the valve face angle. The face of the lap should be finished to the proper angle, say, 59 to 60 deg. It is then carefully charged with the lapping compound, an abrasive in the flour class. The lap is mounted in a collet of, preferably, a lapping lathe, the shank lubricated with mutton tallow and you are ready to begin.

The nozzle body is slipped over the lap, care being taken to keep the abrasive away from the bore. A light cut is taken in accordance with the usual lapping procedure. Examination of the face of the lap will tell if the contact is as desired. If not, the angle should be changed using a double-cut, dead-smooth file. It is a cut and try proposition until the correct angle is achieved. Lapping is then continued until the seat is cleaned up. Now, when the valve is inserted, after careful washing of the nozzle body to remove all abrasive material, a perfect and lasting seal will be obtained.

"Here comes old grimy fingers again."

By the way, when cleaning those lapped parts, let's not handle them while dry or wipe them before final assembly with rags or waste. Frequently, a fingerprint that would do the FBI's heart good will be found etched on a lapped part as the result of body acids. Keeping the hands and parts wet with a fuel oil or solvent and careful handling when dryness is required will avoid this damage to the closely fitted parts.

When given the final washing, parts should be blown dry if necessary. Usually a light oiling is desirable. In any case, the lint from rags and waste will do absolutely no good during assembly.

Summary

When all this is boiled down it amounts to only a few basic ideas: avoid dirt as a plague; show respect for the precision with which the equipment was built; and use good old horse sense at all times. You will be surprised how this will cut the bills for injector maintenance and in addition you will not offend our injection equipment expert who is just about as sensitive in his own way as the "innards" of that equipment.

SAE Oil Grades Revised

A recent revision of the SAE Crankcase Oil Classification is intended to set up oils for a wider operating range than its predecessor. Recognition has been given to the "W" or winter classifications and 5W oils have been added. High viscosity oils, 60 and 70 grades, have been eliminated since they had extremely limited application.

The 5W oils are considered desirable for subzero operation, particularly cold starting. Studies by a group of the SAE Fuels & Lubricants Committee, in cooperation with CRC, showed that 5W in place of 10W gave a 33 per cent increase in cranking speed at equal temperatures. Research also showed satisfactory viscosity stability, oil consumption and wear resistance for 5W oils.

Operation at subzero temperatures, of extreme importance at this time, previously called for cutting back the specially listed 10W oils with kerosene. Viscosity stability suffered. The 5W oils can be operated well below —10 deg. F without this disadvantage.

The revision is more logical as the viscosities are specified at temperatures closer to those at which the oils operate.

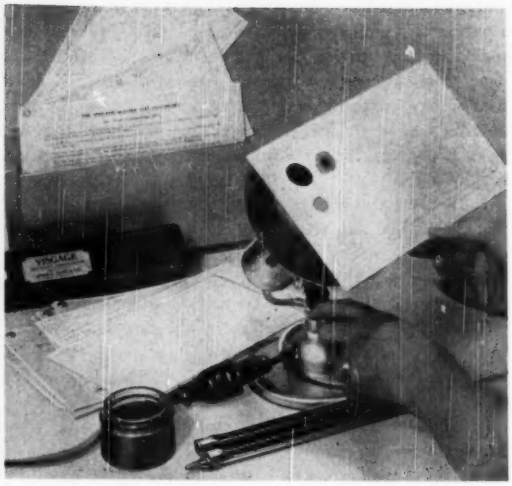
Table 1 – Revised SAE Crankcase Oil Classification

SAE Viscosity Number	Viscosity Range, Saybolt Univ., Sec. at 0 F Min.	at 0 F Max.	at 210 F Min.	at 210 F Max.
5W	–	4,000	–	–
10W	6000 (Note A)	less than 12,000	–	–
20W	12,000 (Note B)	48,000	–	–
20	–	–	45	less than 58
30	–	–	58	" " 70
40	–	–	70	" " 85
50	–	–	85	110

Note A. Minimum viscosity at 0 F can be waived provided viscosity at 210 F is not below 40 Saybolt Seconds Universal.

Note B. Minimum viscosity at 0 F can be waived provided viscosity at 210 F is not below 45 Saybolt Seconds Universal.

Sample of oil is taken by Visgage (in operator's hand) and put on blotter which is used with electric oil spot tester.



Operator turns on light and tilts spot tester to viewing position. Appearance of spot gives some indication of oil condition.

On-the-Spot Lube Oil Evaluation

USED lubricating oil contains clues to the condition of the engine which if properly interpreted and acted upon will permit faults to be corrected before they become serious. The oil circulates through practically every part of the engine and is the logical collector of the various contaminants. Its intimate association with the pistons and liners brings it in contact with the by-products of combustion and these, in the form of fuel soot, carbon, acidic components, etc., will build up in the oil.

In evaluating operation by analysis of the oil the greatest stress should be placed on trends rather than on specific quantitative amounts. It is known that contaminants will accumulate even in the best of engines with the best of lubrication filtration. The efficiency of the latter will be best indicated in the rate of build-up. Rates, then, are important and the only means of determining these is by consistent and periodic checks.

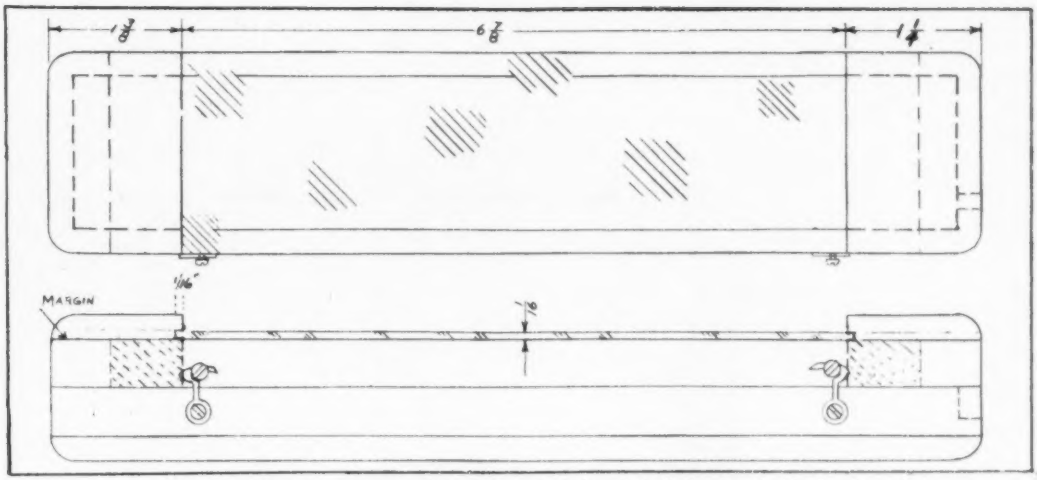
The problem then resolves into a means of conducting these necessary tests for plotting trends and determination of what to look for. In the latter case the specific objectives are to find the viscosity as an indication of fuel dilution, soluble and insoluble contaminants and acidity. These are the most important factors affecting the suitability of the oil for further use. Deviation from the normal rate of build-up of these contaminants is a sign of trouble.

For example, a rapid jump in the established rate of dilution might indicate dribble or clogging of an orifice in a nozzle, a stuck needle, a pump delivering too much fuel, incomplete combustion due to poor compression resulting from stuck or broken rings, or even a direct leak of the fuel into the lube oil. A rapid build-up of fuel soot, carbon or sludge in the oil might be an indication of blow-by tied in with poor compression as mentioned above or an indication of clogged or otherwise inefficient filtration. The acidity curve might jump also as the result of blow-by permitting combustion by-products to reach the oil more readily, rapid oxidation resulting from abnormally high operating temperatures or perhaps be the result from the use of a fuel with a higher sulfur content than normally used.

Equipment is now coming on the market making it possible for the operating engineer to conduct his own tests to determine as a trend what is going on in his engine. One interesting development along these lines is the extension of use of a piece of equipment, the *Visgage*, now in the hands of a number of operators.

Basically, this instrument is a means of measuring viscosity by comparison. There are two glass tubes mounted on a calibrated metal scale. One tube is filled with a reference oil of known viscosity and the second is provided with a suction plunger for drawing in a sample of the used oil. There is a metal sphere in each tube and when the instrument is tilted to an angle between 30 and 45 deg. these roll downward through the oil. The position of the second ball after one has completed its travel is noted and read against the scale to determine the viscosity. Readings are in seconds, Saybolt Universal.

Temperature, as in the case of all measurements of viscosity, is important and present owners of this equipment will be interested in the modification of the protective case of the latest models. The alteration can be made in accordance with the accompanying drawing. The case is now used to house the instrument and protect it



Dimensions of Visgage carrying case which can be made draftproof. Hatched portions in side view show neoprene pads which are cemented in and hold the visgage from shifting.

from drafts during the period when the temperatures of the two oils are being allowed to equalize. In addition, the temperature influence of handling is eliminated and the glass front affords good vision.

Viscosity readings obtained are quite accurate and it is interesting to note that compensation can be made for oils of widely varying viscosity index by simply bringing the temperature of both oils to 100 deg. F at which point the index factor cancels out.

The new oil viscosity and that of the used oil being known, these figures can be applied to a chart supplied by the instrument builder. The chart is arranged with viscosity in SSU plotted against percentage of dilution. By selecting the column headed by the new oil reading and following it down to the used oil reading and then looking left to the percentage ordinate, the degree of dilution is read directly.

Thus one of the objectives and certainly one of the most important has been achieved. Further evaluation of the oil is possible through the use of a new development of the Eitzen firm. It is a blotter test involving the use of an electric oil spot tester, test papers each with locations for 18 successive oil spots and cards for recording the data.

The spot tester provides a means of heating and drying the oil spots and later illuminating them for inspection. After the viscosity has been determined, two drops of oil are carefully placed in the center of one of the circles on the test paper. Prior to this the paper will have been placed on the tester that is adjusted to hold it horizontally.

The heat of the dryer drives off the light ends and any moisture from the oil spot. When completely dry, the head of the instrument can be adjusted for easy viewing.

In appearance the spot will consist of a dark center with a lighter colored corona. The spot will contain the bulk of the soluble and insoluble contaminants in the oil and by means of visual comparison with other spots the trend of this type of contamination can be established. It serves, also, as a good check on the effectiveness of the oil filtration as it pertains to removal of the carbonaceous materials, sludge, etc. Microscopic examination of the spot will give an indication of the extent of the metallic contaminants and these can be separated into two groups with a magnet as being ferrous and non-ferrous.

The light stain around the dark spot is caused by the acidic components. The greater the degree of acidity, the darker will be the color ranging from a pale yellow to an orange. One difficulty encountered in the correlation of results is the fact that the colors will vary for the same degree of acidity with different oils. However, the operator is interested in trends and working with the oils he commonly uses, can arrive at a satisfactory arbitrary scale.

Obviously, these devices do not give a complete and detailed evaluation of the oil in the laboratory sense, but with a little experience and common sense, the operator can determine definite trends. These do permit him to obtain an on-the-spot evaluation as a guide and by denoting departures from the norm, warn him of irregularities in his engine operation.

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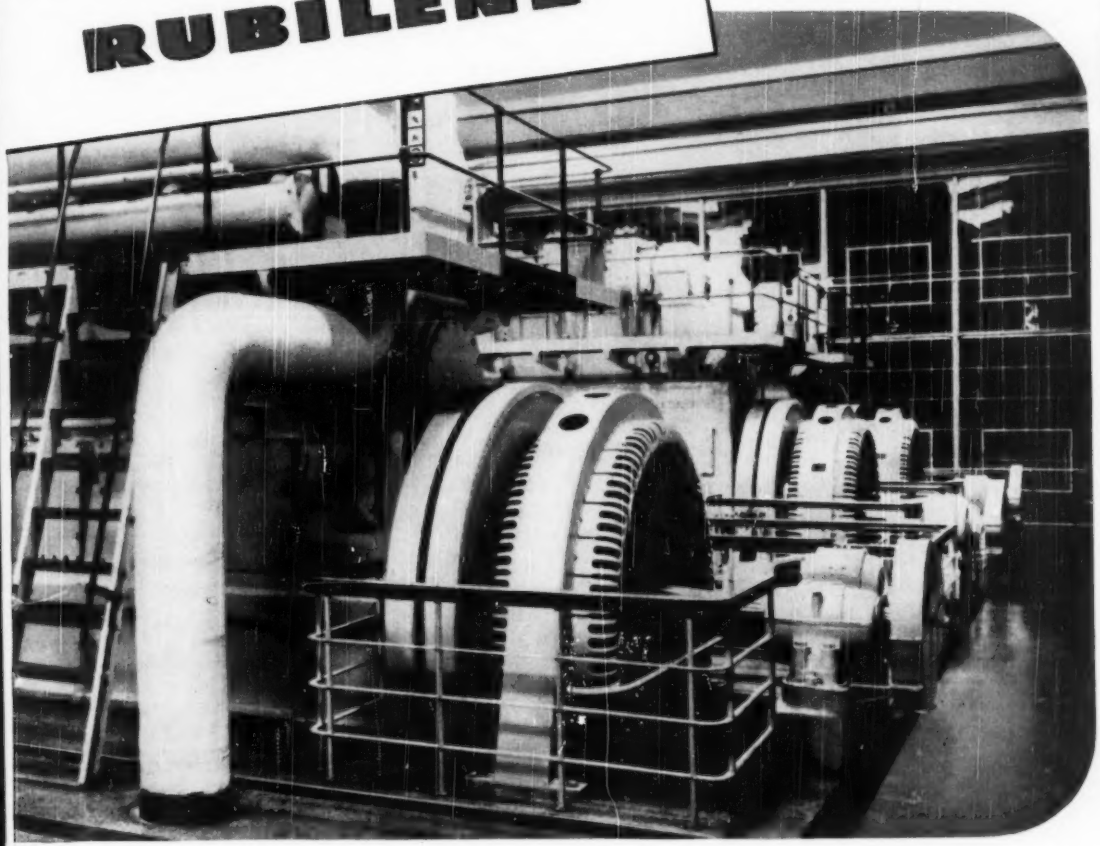


INDUSTRIAL OILS

Recognizing the Causes of
Valve Failures

by Vincent Ayres
Eaton Manufacturing Co.

ENGINE valves play an extremely important part in maintaining engines at top efficiency. In a sense they can be compared to piston rings in that they are essential to seal against the forces of combustion, are required to operate at elevated temperatures, and are difficult to cool.

There are problems peculiar to their design and function that must also be considered. Repeated cycles of acceleration and deceleration accompanied by impact at the sealing faces call for a high degree of design refinement. This carries through to the actuating mechanisms that must cause the valve to function properly while at the same time being vulnerable to wear, thus introducing mechanical irregularities.

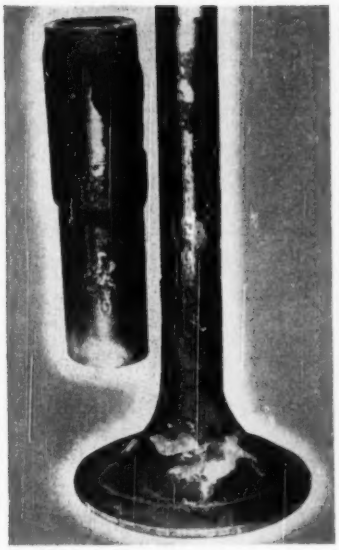
Sealing by a mating of two metal faces poses the problem of extremely accurate geometry of all of the components. Valve guides must be accurately located and snug enough to properly guide the valve on to its seat. Both the valve head and the seat must be concentric with respect to the axis of the guide bore.

Valve heads and seats must be able to withstand heat, abrasion and impact whereas the stems must resist seizure and galling. Lubrication of the stems must be adequate without being excessive in order to avoid harmful carbonaceous deposits resulting from the high temperatures normally encountered.

This is, admittedly, an extremely difficult set of operating conditions. The scope of this text is concerned with the matter of design only to the extent necessary to understand the problems involved. The principal objective is to point out to the operator or mechanic some of the more common evidences of irregularities in the valve system so that corrective action may be taken. Attention to details can greatly extend the useful life of valve equipment.

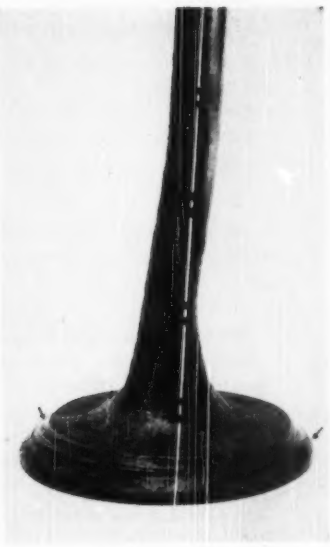
√ Valve Sticking

Possible Causes	Corrective Procedures
Faulty Clearance—Inadequate clearance prevents proper lubrication, creating heat through marginal lubrication. Seizure, scuffing and galling will follow. Excessive clearance permits formation of gummy materials from oil attacked by entry of hot gases.	Proper clearance must be established by replacement of the valve, guide or both. Condition of the surfaces is a consideration affecting replacement.
Improper Lubrication—Inadequate lubrication creates heat leading to scuffing, galling, seizure, etc.	Sludged or otherwise obstructed oil passages may retard oil flow and must be cleaned. Oil pressures should also be checked.
Excessive lubrication generally results in leakage past the end of the guide into high heat zone where objectionable oil breakdown and deposits occur.	Oil pressures too high or excessive clearance (see above) can cause overlubrication. Any seals used in the system should be checked.
Unsuitable oils may not be able to resist temperatures encountered thus creating gums, etc., causing sticking.	Oil with good heat resistance should be used. Oil cleanliness is also important.
Improper Cooling—Abnormal cooling water temperature, damage or absence of cooling jets, scale or sediment adjacent to seats, all interfering with heat transfer, can cause excessive valve and stem temperatures. Thermal expansion may reduce lash dangerously.	Cooling system should be checked to insure correct operation. Special attention should be given to the cored passages and cooling jets associated with the valves. Sediment and scale must be removed. If extreme, attention to water treatment is indicated after correction. Good heat transfer is essential.



High stem temperature from poor heat dissipation, perhaps due to loose fits, destroyed an unsuitable oil, creating deposits on stem and behind guide and sticking.

Definite evidence of sticking due to deposit formation. Effect of sticking is shown as guttering of valve face. This illustrates interrelation of types of failure.



Bent valve with white line showing axis of stem within guide. Bending occurred during installation and operation was sufficiently long to create new and off-center seat.

Continued sub-normal temperatures can similarly result in excessive lash.

Cold operation requires check or installation of thermostats or regulating valves.

Bent Stems—This purely mechanical fault is generally the result of careless handling or accidental blows during engine work.

Use of good mechanical practices and care during engine work is the best solution to accidental damage.

It may also result from improper adjustment or geometry of the actuating mechanism.

Periodic checks on valve lash, linkage wear, rocker noses and tip wear will minimize trouble from the actuating mechanism.

√ Stem and Guide Wear

Possible Causes	Corrective Procedures
Faulty Lubrication—Insufficient oil, resulting in marginal lubrication, will promote wear.	See "Corrective Procedures" for "Improper Lubrication" under "Valve Sticking".
Excessive clearance will hinder film formation with the same effect.	Clearances must be restored to the recommended minimum.
Initial installation without lubrication may cause galling and scuffing during break-in. Marred surface finish promotes later wear.	During installation, valves should be pre-lubricated, preferably with an extreme pressure type oil with good heat resistance.
Eccentricity of Components—If either valve or seat is eccentric with respect to the guide bore, lateral motion will result when the valve tries to seat. The valve stem cocks in the bore causing metallic contact and wear.	Correct alignment as in "Corrective Practices" under "Valve Face Failure-Burning".

Possible Causes (cont.)

Poor Geometry—Actuating mechanisms, particularly rocker arms, cause some side thrust. This can be accentuated by too deep a location of a valve or wear in the linkage that may cause a similar condition.

Condition of valve tip and rocker arm nose will sometimes increase side thrust.

Corrective Precedures (cont.)

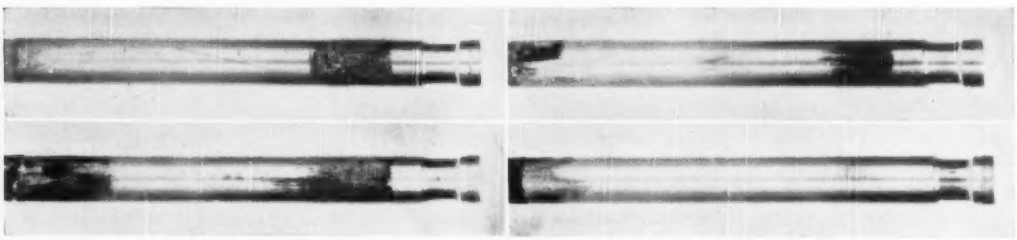
Carefully check all the mechanical considerations including an examination of the valve tip and rocker arm nose and make necessary correction.

Grinding will frequently correct tip and nose irregularities but care should be taken to obtain good final finish. Where case hardened, grinding is not applicable.

Note: Surface finish of the guides and stems will greatly affect wear. The critical period is during break-in when the surfaces are conforming. Finishes as fine as 5 micro-inch have been used but are not the complete answer. They also present manufacturing problems. Use of special oxide coatings such as the manganese-iron-phosphate Parco-Luberizing process is becoming more popular. Such coatings are very helpful during the break-in period and will work well applied to a rough-reamed guide bore working in conjunction with 30-40 micro-inch valve finishes. If equipment of this type is used originally, every effort should be made to replace with the same type.

Typical examples of stem scuffing. Photos stress importance of stem and guide finish relationship. Below, 5 micro-inch (top) and 30-40 micro-inch (bottom) valves in untreated bearingized guides.

Improvement is shown by 5 micro-inch (top) and 30-40 micro-inch (bottom) valves in manganese iron phosphate treated, rough reamed guides. Marking in first two photos is typical of scuffing regardless of cause.



√ Valve Face Failure - Wear or Grooving

Possible Cause

High Impact—Weak or cocked valve springs and excessive lash will create high seat impact. These spring conditions permit "free fall" of the valve on its seat since the cam follower rides off the cam at the top of its rise and instead of riding down the flank, easing the valve on its seat, permits it to fall.

Too much lash also permits uncontrolled seating.

Loose Guides—Guides that are loose or bell-mouthed permit some lateral movement of the valve. This permits relative movement of the sealing faces, producing wear.

Conversely, misalignment of valve and seat causes valve to slide with lateral motion onto seat and this condition may cause bell-mouthing.

Corrective Procedures

Valve springs should be checked for proper installation and tension. Weak springs should be replaced.

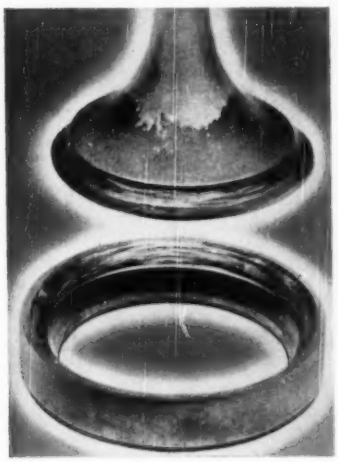
Valve lash, as mentioned, should be periodically adjusted. Hydraulic lifters automatically correct the clearance. Hydraulic lifters, if used, should be checked at overhaul to insure proper leakage rate because if worn and leakage too fast, high seating velocities can result.

Minimum recommended valve to stem clearances must be established and a check should be made on alignment to see that it is not causing guide wear which in turn contributes to valve face wear.

If the above is impractical for any reason, some relief may be obtained by changing the seat angle, for example, from 45 deg. to 15 deg., thus reducing the lateral movement of seating.

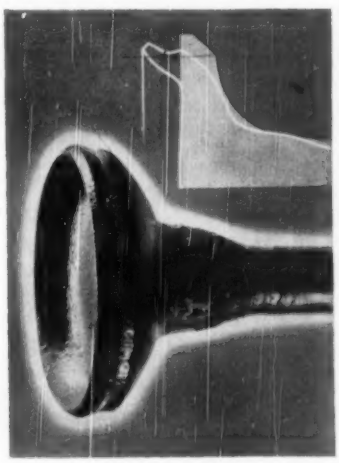
Seat Distortion—Distortion will result in localized contact and high unit pressures. It can also create the condition mentioned above as well as leakage and face burning.	See "Corrective Procedures" for this condition under "Face Burning".
Dirt—Scavenging air may carry entrained dirt that acts as an abrasive between the mating faces.	The air induction system, filters, etc., should be checked.
Seats Too Narrow—High unit pressure is caused by narrow seats and if material is inadequate or sliding and wallowing occur as mentioned above under "Loose Guides", a high rate of wear takes place.	Wider seats are one answer but the compatability of seat and valve material with regard to wear as well as the geometry may be checked.
Material Inadequate—Incompatibility of the valve and seat material as bearing materials is a factor particularly where any sliding occurs. Unsuitable hardness and low resistance to impact may cause wear and grooving.	Unsuitable materials are generally introduced during replacement. Care should be taken to replace with the same materials or in the event of failure of original equipment, the builder or a competent valve specialist consulted.
Corrosion—Corrosive by-products of combustion in conjunction with water vapor may form harmful acids that attack valve faces.	Use of more corrosive resistant materials or fuel with a lower percentage of sulfur will help.

Valve face and seat insert share wear due to seat distortion. Wear started with localized contact in one area and eventually worked around entire face.



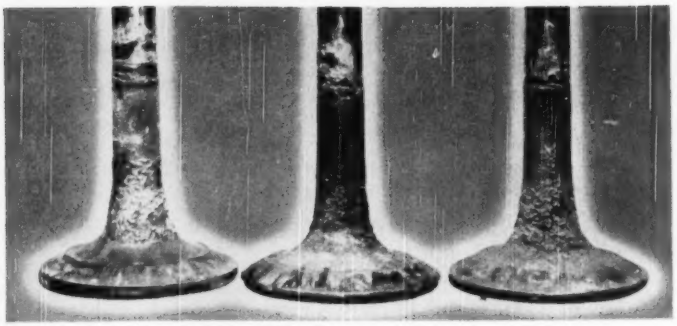
Face of an inlet valve worn concave as the result of dirt getting by the air intake filter. This is almost pure abrasion and the degree of face and seat wear will be roughly in proportion to their comparative hardness.

Excessive temperature reduced valve head strength and high seating impact, heavy spring loading, or both, deformed head, changing contact angle about 45 deg.



√ Valve Face Failure - Burning

Most face burning, frequently evidenced as guttering or cracking is the result of leakage caused by any of the irregularities to be discussed. Minute leaks permit high pressure and temperature gases to escape at high velocity creating localized heating and high temperature oxidation or thermal cracking. In the case of cracking, high impact is a contributing factor. The area of leakage rapidly increases once a foothold is gained. Devices to rotate the valves can help distribute effects.



At left is guttered face of inlet valve due to excessive deposit formation. Portion of deposit broke away permitting leakage. Consequent flow of high temperature and velocity gases soon eroded the base metal.

Similar condition with gasoline engine valves. Condition is typical of oxides of lead attack but also approximates diesel conditions. Sticking, deposit formation and breakaway, leakage and face-burning follow in sequence.

Possible Causes	Corrective Procedures
Eccentricity of Valve Face or Seat—Due to the constraining influence of the guide, any eccentricity of the mating faces with respect to the axis of the guide bore will cause leaks.	Eccentricity must be removed by correct grinding of the offending component. A pilot in the guide bore is generally the reference for seat grinding and the valve stem serves during face grinding. Both faces and seats should be ground with equipment that will produce true surfaces without chatter. After grinding, concentricity should be checked to be within proper limits.
Seat Distortion—Leaks from this cause may result from excessive or uneven temperatures around the seat.	Troubles arising from temperature are generally a function of the engine cooling system. Check under "Valve Sticking".
This condition also occurs from uneven tightening of head bolts, adjacent manifold studs, etc.	If mechanical, permanent deformation must be eliminated by machine work and maintained by proper tensioning technique.
Deposits and Blow-by—Deposits will sometimes form on exhaust valve seats due to combustion by-products and ash. Even coatings may help wear but perhaps deter heat transfer. Should portions break away, leaks can occur.	Create higher unit pressure to break through deposit by differential angle between seats and faces or reduction of seat width. Rotators will help to retard formation and will also distribute localized effects over entire valve face.
Under certain marginal conditions, combustion pressures may be sufficient to cause blow-by.	Blow-by may be stopped by using a differential angle between valve and seat to form a ring seal or reduction in seat width to give higher unit pressure.
Slightly Open Valves—Sticky stems or inadequate lash clearance may hold the valve off its seat during combustion.	See under heading "Valve Sticking".
	Frequent check and adjustment, when necessary, of the valve lash is an important maintenance item. Hydraulic lash adjusters will automatically insure proper seating and improve operation.

Material Inadequate — Valve faces may lack resistance to temperatures encountered. Face burning may occur at the moment of opening, particularly if geometry is poor and opening takes place first at a single point.	Heavier duty valves should be used. This may involve better materials or hard facing. Alignment should be checked. Rotators may help by distributing over the entire face any tendency to burn at a single point.

√ Other Valve Failures

Types and Causes	Corrective Procedures
Stem Necking—Conformation of the valve seat and head is such that when the valve opens, the hot gases are directed against the stem. Stems may erode until actual breakage occurs.	This situation can be helped by use of valve materials with greater resistance to high temperature oxidation and erosion and by improvement of valve cooling. Failing this, inspection should be made regularly to permit valve replacement before breakage and subsequent engine damage occurs.
Breakage—This may be the ultimate result of the functional failures mentioned. Abnormal loading, principally impact, can result from overspeed of the engine, and the items mentioned in "Valve Face Failure-Wear. . . " under "High Impact".	All the corrective action mentioned, where applicable, will avoid breakage. Overspeed is an operational or governing problem.
Head Dishing—Cupping is an indication of structural inability to withstand the loads imposed on the seat area. It can result from high impact, low strength of the metal at extreme temperatures, and heavy valve spring loads.	Use of a better valve material will help this problem. High impact and spring loads are largely mechanical problems and can be corrected by installation of properly tensioned springs, correct lash adjustment, avoidance of overspeed, etc.
Structural weakness and overheating can also be the result of excessive grinding when refacing. The thin section interferes with heat transfer and is obviously weaker. This can be accentuated by repeated grinding of the seat, enlarging its diameter and moving the location of seating out on the thinner section of the valve head.	Limitations on face and seat grinding will avoid thin sections and locate the actual seat somewhere near the middle of the valve face.

Summary

It can be seen from the unavoidable repetition and cross references that there is considerable interrelation between the various troubles encountered with valves. It is seldom possible to pin a failure to a single cause. Therefore, all the possibilities must be considered when analyzing a valve failure even though the characteristics appear to indicate one particular type.

The clue to the reason for failure might lie in some interrelated component of the system and it is the reason for failure that is important. It is not enough to simply replace or repair the part: If the "why" is not found, early failures is to be expected.

Design of the entire valve system is an extremely complex job but one that has been carefully worked out by each engine builder. It must, therefore, be assumed that the original equipment is capable of satisfactory life in the expected engine applications.

Premature failure, then, is generally the result of abnormal service conditions, improper operation or maintenance, or use of unsuitable replacement parts. Where severe service conditions indicate recourse to better materials in parts, rotators, etc., the move should be made cautiously with the advice of the builder or a competent valve specialist. Improved maintenance and overhaul procedures should take care of all other conditions.

Chemical Descaling Simplifies Block Rebuilding

*by R. K. Brunke**

BLOCK rebuilding is an essential and important part of engine overhaul. Whether an independent engine rebuilding and repair shop or the overhaul department of a user organization, ways of simplifying the rebuilding work and reducing its cost is of great interest.

Most of the successful operators handle general cleaning procedures somewhat alike in their block rebuilding work. With efficient cleaning procedures you prepare surfaces of parts so that repair or replacement is simplified and so that a good refitted block can be turned out quickly.

This has led to a certain amount of beneficial standardization in the cleaning procedures. But dependable opinions hold that regular revision of the standards upward is worthwhile so that the overall cost can be lowered. The next step is to keep on the lookout for all ways of bettering the end product—a good rebuilt block.

Importance of Cleaning

Turning out rebuilt blocks and other equipment can be a more efficient process when the important cleaning procedures get more attention. In the not too distant past, cleaning was seen as a necessary evil. Now we know that efficient cleaning can greatly simplify the operation and help the mechanics make the job more productive and thorough. We have watched the development of materials and methods for hot tank cleaning of short blocks and parts, the qualities and limitations of steam cleaning and solvent soak coolant. Such a block can easily become a failure when put in service during the break-in time. It goes without saying that overheating an engine, particularly during that period, is something to be concerned about.

Removing scale to make rebuilding easier may now be accomplished with a special acid type material. In general practice, blocks are first inspected for fractures and fissures to eliminate the junkers before expensive parts and labor are expended. After removing grease and dirt with one of the specialized alkaline cleaning materials, a properly inhibited acid type material is circulated to remove this insulating scale. This makes it easier for you to show up the fractures in pressure tests. Blocks that border between good and bad can be definitely evaluated with this effective method. But in making great strides toward efficient block cleaning and rebuilding, one process which has come into its own as a standardized process is the circulation method of descaling and derusting automotive type engine blocks. Let us turn our attention to this important procedure.

Common Problems

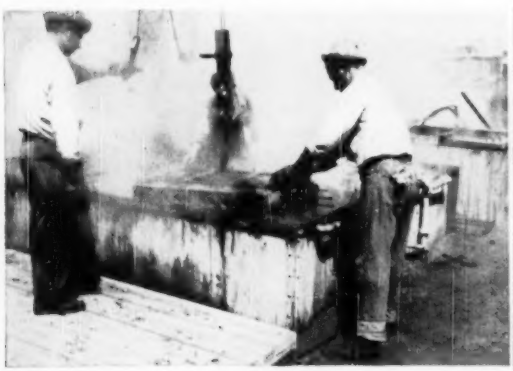
At one time or another any automotive type engine which uses water as a coolant will acquire a build-up of scale or rust or both. Almost all blocks received for rebuilding are coated with scale and rust in varying degrees. Scale, probably the most troublesome, is composed of magnesium and calcium carbonates, and other impurities frequently found in water.

The presence of scale can cause many difficulties. Chief among these is the fact that even a minute thickness of scale can insulate the cooling area immeasurably, thereby lowering the effectiveness of the descaling, thus eliminating many comebacks.

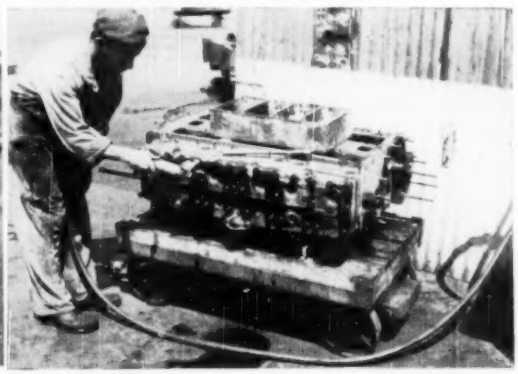
Circulation Method

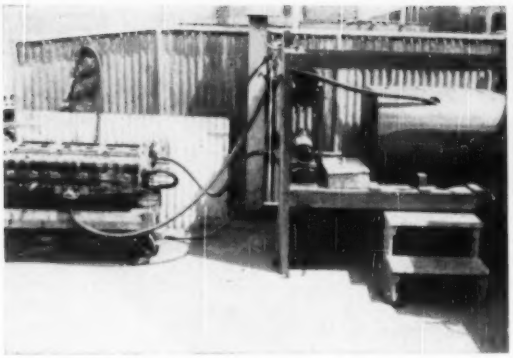
The manner in which a shop sets up the circulation method of removing scale and rust and other solids from

Mechanics lower engine block into degreasing solution to remove grease and sludge. This is the first step in the cleaning process. (All photos courtesy of Pacific Electric Railway Co.)

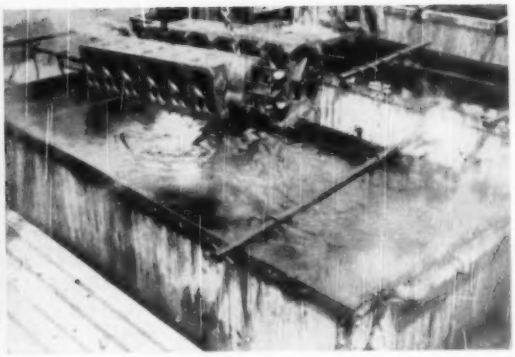


Here, the mechanic tightens head bolts to complete circulatory system in the engine prior to circulating descaling solution through passages. This also serves to descale the head.





Block being descaled by circulation method. Hose lines carry solution from tank at right through passages in block and back to tank. The solution is surged through the block for greater effectiveness.



Final step in cleaning blocks is removal of scale which was loosened by circulation method. The head is removed and the block immersed in a solution which neutralizes any acid which may be in the block.

blocks is governed by the volume of production, types of blocks, space and equipment. The most efficient way to implement this method is to work with a rubber-lined tank as a reservoir, rubber hose, pump and various size plugs necessary to complete a circulating system through one or more blocks. This way the same solution of the inhibited acidic material can be used over and over again in the recirculation set-up. It is probably the most efficient, most economical arrangement that can be used because the cleaning ability in the acidic material can be completely utilized, which means that more area can be descaled and cleaned with a minimum amount of material. The material is not dumped until it is completely dissipated.

This method gets some of its effectiveness from the way the solution is circulated. Instead of being continuously circulated, the solution is occasionally surged through the system. The pumps may be run a few minutes and then be shut down for 5 to 10 minutes until the cleaning solution has been on the surfaces for about an hour which is the average time required for most block-descaling work.

This intermittent circulation procedure allows the inhibitor to do its work of protecting metal from attack. Where more than one block is being descaled at the same time, each block is tied in to the other with lines to complete the circulation system. Confining the descaling action to the desired area offers the maximum results from the material.

Soak Method of Descaling

The method most generally in use for treating blocks individually is the soak method. It requires a minimum amount of equipment and hookup time, and is a great help to shops that do not necessarily operate a production line set-up, but are handling various types of blocks daily. All the equipment needed is a catch tank or pan and a rack or leg structure to hold the block upright so the cleaning material contacts all soiled areas. Lower openings are plugged and the water jackets filled to the top with the cleaning material solution.

The cleaning material for the soak method can be used in concentrations ranging from 30 to 50 per cent. The previously mentioned circulation method may employ a slightly lower concentration without retarding the progress of the operation. The higher concentration required for the soak methods speeds up the cleaning action. Provision can be made to recover the descaling material and salvage it for the next block. Where necessary, more of the cleaning material may be added to bring the concentration up to the required working strength.

A variation of the soak method is currently being used successfully on a number of established operations. This process is accomplished with the use of a tank of sufficient size to handle the run of work in the shop. After the grease and dirt have been removed with a specialized cleaning material, the blocks are immersed into the descaling material for a period of time sufficient to produce the scale-removing action.

Mechanical agitation of the solution in this method helps to shorten the soaking time. Air agitation should not be used because it might drive off objectionable gases as well as shorten the life of the solution.

To get maximum descaling work out of this acid material, either of the two other methods are recommended, because the chances of contaminating the solution are increased as the solution contacts wider fouled areas. Confinement of the descaling solution to the scaled areas is certainly a great advantage. By comparison, in the tank method, enough solution must be provided to surround the entire block inside and out. That means there is usually more dead space in the tank on which the descalant is working than there is scale-covered area. Overworking the solution this way dissipates it more quickly.

A point in favor of the tank method is that blocks can be processed without the liners in place. In the other two methods with engines having wet liners, the cooling passages must be kept intact to contain the descaling material. Various types of seals are used in conjunction with the liners and these should be carefully checked for damage caused by chemical attack and replaced if necessary. Little difficulty, however, is encountered when using inhibited acidic materials.

Thus, it will easily be seen that the first two methods are usually recom-

**Oakite Technical Service Representative. From a speech delivered at the 1950 Automotive Engine Rebuilders Association Convention in St. Louis, Mo.*

mended as the most efficient and most economical. But local conditions, such as the number of units being descaled, the availability of equipment and manpower may make descaling by the tank method your choice. In all cases, the decision must be made with an eye to all these important factors.

Important Points

In considering the various processes discussed, it might be well to remember several important facts:

1. Solution holding tanks or reservoirs should be rubber lined, lead lined, long leaf yellow pine tongue and grooved wood, earthenware or stainless steel of a suitable grade.

2. Connecting lines should be fabricated of a good grade of rubber hose.

3. An acid resistant pump is recommended.

4. The blocks must be thoroughly degreased by hot tank method prior to the descaling process.

5. Thorough rinse is required between hot tank cleaning (to remove loose grease and dirt) and the descaling operation.

6. A thorough rinse is also required following the descaling operation after which the blocks should be submerged in a tank of hot alkaline solution to neutralize the descaling solution.

Experience A Help

Some block rebuilders may have experimented with certain descaling methods to their sorrow. Briefing yourself with tested and workable knowledge freely available to you through the representatives of manufacturers of specialized scale-removing and cleaning compounds, such as Oakite Products, Inc., can be extremely helpful.

You will learn the important differences and advantages between an inhibited and an uninhibited descalant. You will learn that descaling should be done only with acid materials properly compounded so as to minimize attack on the base metal while still providing the important "wetting out" activity. Attack on the base metal is a great deal more important than some rebuilders admit. The more violent the attack on the metal, the more hydrogen embrittlement is set up. This action produces a weakening of the surface of the metal which might eventually become porous and open up the structure of the metal for extensive damage.

We have found that uninhibited acids reacting with bare metal form ferrous salts in the solution which quickly shorten its life, thus stepping up the cleaning costs. The action of the inhibited acid type descalant is such that after the scale is removed the inhibitor itself "plates on" the surface to insulate it against the action of the acid. That is why it is recommended that the descaling solution in the circulation process, mentioned before, should be allowed to stand quiet part of the time. That way the mechanical action is not turbulent enough to wash off the inhibitor. Important, too, is the fact that the inhibitor is compounded exceeding 140 deg. F. Room temperatures provide proper conditions so this descalant can do its best work.

In-Place Cleaning and Descaling

We can touch lightly upon the established process of descaling blocks and radiators that are in place, for example, in a bus or truck chassis. This work is being done successfully by fleet operators in the following manner:

1. A suitable alkaline material introduced as a solution into the circulating system to desludge it thoroughly. Engine may be run 20 to 30 minutes at slightly above idle speed at temperatures controlled to about 190 deg. F (restriction of air supply will control temperature).

2. Flush well and introduce a 30 per cent or less solution of the recommended inhibited acid material. Circulate for 1 or 2 minutes and let stand for 7 to 10 minutes over a period of a half hour, or longer if conditions warrant.

3. Flush system, and again introduce the same type material, as used in Step 1, in a mild solution to neutralize the areas. A final flush rinse returns the system to efficient operating status.

Identification of Materials

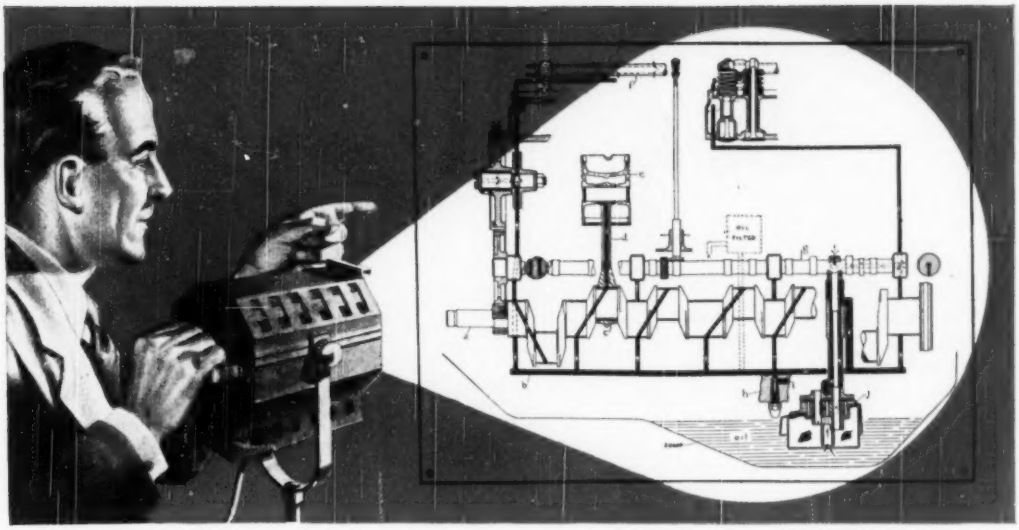
Neutralization work mentioned in this article may be handled with most any one of the alkaline materials you may now be using for degreasing in your hot tank. A number of proprietary compounds are available. These materials would be used in the grease-removal and neutralization steps of all the processes discussed here.

The first step, removing grease and other soils, is very important to all engine descaling work because it prepares the way so that the acid material can go to work quickly and do a better descaling job. The neutralization process is also highly important because it ends the descaling activity once the scale has been removed.

The value of a fast-working descaling material in your shop cannot be exaggerated because along with block rebuilding goes the work of reconditioning valves, poppets, push rods, keepers, nuts and bolts. The particular descaling material serving as a basis for previous comments is Oakite Compound No. 32 and it is suitable for this job too. Those parts can easily be brightened, after the grease and dirt are removed by hot tank cleaning, by submerging them in a 30 per cent solution. Rinsing and neutralization as recommended for engine descaling also follows this procedure.

Then as a protective measure, a product such as Oakite Special Protective Oil cut back 50-50 with mineral spirits, for example, Stoddard solvents, provides excellent protection against rust at little extra cost. With proper handling and holding of this anti-rust solution, it is not necessary to dry down the parts before dipping them in the protective oil solution. This rust preventive disperses the water, thus saving a wiping operation.

Of the many materials available one may wonder which to use under a given set of circumstances. All the materials are developed to answer a special need in your shops. The recommendations for any one of these materials can vary with the water condition in your locality, the time element and the type of equipment. Technical service representatives in your locality can be particularly helpful in making specific recommendations and to assist in setting up these various operations so they function on a workable, practical basis.



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Some Considerations of

Crankshaft Regrinding

*by F. P. Healy**

Expensive crankshafts that are worn or damaged within reasonable limits can generally be reclaimed by regrinding of the bearing surfaces. Successful service life of the reworked shaft is a function of —

- **Workmanship**
- **Quality of Tools**
- **Know-how**

REGRINDING is the generally accepted method of restoring worn or damaged crankshafts for further useful life. Obviously, there are some limitations as to the severity of conditions that can be restored by this method. Shaft design provides for the necessary strength, rigidity and bearing area and, therefore, excessive grinding will affect all three requirements.

Common faults that can be corrected by grinding include out-of-round, tapered or "cammed" bearing surfaces and those that have been scored, abraded or otherwise damaged. The permissable depth of grinding for clean-up is a function of shaft diameter, heat treatment or depth of hardening, etc. Practical limitations are imposed, however, by the available undersize bearing shells and the recommendations of the engine builder. Any excess of these limitations creates a special problem with regard to future maintenance and is a risk assumed by the engine owner.

Crankshaft manufacture is a tricky job at best, representing an accumulation of knowledge applied to production techniques. It follows that the regrinding, paralleling the pattern of manufacture, is an equally ticklish job further complicated by the fact that most shops engaged in this work must be set up to handle a variety of work.

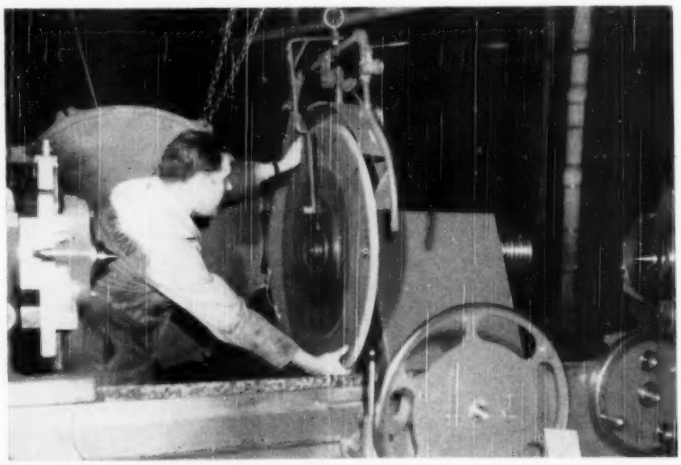
The scope of this article is intended to cover the highspots and considerations of regrinding practices. It should give the individual a better appreciation of what is involved when he picks up the tab for such a job and enable him to better evaluate the quality of the work. To those embarking on a regrinding project, it will provide a general background concerning the problems involved. It would be presumptious to think that this text could add to the comprehensive data supplied by reginding machine builders or to the "know-how" of those already engaged in the practice. Perhaps, in this instance, it will serve as a refresher or check list.

Shaft Straightening

Shaft straightness is frequently not considered to be a factor on the basis that the regrinding will true the shaft anyway. This is a short-sighted attitude because it is a waste of usable material and expensive from the machine time angle to take off more metal than absolutely necessary. In addition, dynamic balance may be destroyed.

Checking is best performed by supporting the shaft in vee blocks and measuring the run-out with a dial indicator. Center marks in the shaft ends should always be suspected until checked for accuracy and if necessary, recentered. Placing the crankshaft on vee blocks at or near the end journals and rotating permit the point and degree of deflection to be determined. The high spot is then chalked.

Mounting a grinding wheel on the driving spindle with the help of a special supporting bracket. Bracket permits a slight amount of spring while clearing the wheel guard and coolant piping. Note mounting centers on head and tail stock spindles.



**Chief Engineer, Van Norman Company, Springfield, Mass.*

One of the larger Van Norman regrinders operating in the engine rebuilding shop of Koepsel and Love of Salt Lake City, Utah.

Knowledge of the materials and methods of hardening, if any, are important in straightening. Straightening of cast shafts is generally impractical, thus limiting the process to heat treated or induction hardened shafts and those that are not hardened. In most cases the depth of hardness is sufficient to allow for normal regrinding.

Pressure, as from a hydraulic press, is applied at the high spot and the shaft sprung past the line of straightness. Pressure applied and the amount of spring will largely depend upon the diameter of the shaft, the elastic properties of the material and the amount of correction necessary. Determination of these factors is largely a matter of experience.

Shaft springing will introduce internal stresses and to minimize these, excessive deflection is undesirable. Over-correction, with resultant reversal of pressure application, is also to be avoided. Such stresses in the metal will tend to later distort the shaft again so grinding should not follow straightening without an intermediate step of annealing or "seasoning". Low temperature normalizing, not generally exceeding 425 deg. F. has been helpful without materially affecting shaft hardness.

Regrinding Machines

Basically, all regrinders consist of a means of holding and turning the shaft and a grinding head for turning the stone. From here on, each make of machine exemplifies the ideas of the builder as to the best means of doing the job with facility and in the shortest possible time.

References throughout the balance of the text will be based on the line of Van Norman regrinders with capacities up to 120 in. between centers with a 30-in. swing. A good idea of the general construction of the machines will be obtained from the following discussions.

Mounting the Shaft

Shafts are mounted between the headstock and tailstock. Facilities are provided at both ends for holding the shaft on centers or in chucks and also for making the necessary offsets for grinding the connecting rod journals. In the latter case, counterweights for balancing the eccentric mass can readily be attached to the holding fixtures.

Before mounting, attached crankshaft counterweights are removed. This decreases the swing. It also gives better balance when grinding the main journals and reduces the necessary counterweights when the shaft is offset for throw grinding.

If the shaft is to be mounted on centers, these must be checked and the shaft re-centered if necessary. Mounting run-out may be checked at the ends on a true surface such as a timing gear location, etc. When flanged, the outside diameter can be used.

Once accurately centered, a dog is used at each end for purposes of driving. The mounting must be rigid so the tails are clamped firmly but care must be taken so that in the clamping process, no torque is applied to the shaft.

Chucks may also be used in mounting. The jaws are engaged on the flange, directly on the shaft or, preferably, on fitted brass sleeves. The latter process eliminates difficulties with keyways and protects shaft finishes. The drive with chucks is direct.

Shaft offset for throw grinding is facilitated by slides on both the head and tailstock holding fixtures. The precision feed screws are graduated to give almost micrometer accuracy. The graduations permit the same offset to be readily applied to both ends thus assuring parallelness of the finished surfaces with those of the mains. The entire process is speeded by the use of special fixtures and gauges.

Extreme emphasis must be placed on the centering operations so that the entire shaft can be cleaned up with the least amount of metal removed. Rigidity of mounting and attention to balance is necessary to avoid chatter and to obtain good finishes.

Grinding Head and Wheel

Diameter, face width, grit and type of wheel will be determined by the characteristics of the shaft to be ground. Balance is important in avoiding chatter and dressing will have a lot to do with cutting and finish.

Before mounting a new wheel, it is "pinged". If sound, it will ring when tapped gently whereas a dull sound indicates a defect. It is then mounted on a wheel center and retained by a flange. It is important that washers of blotter material be interposed between the wheel and the clamping surfaces and that the fastenings are not excessively tightened.

The wheel center is provided with two movable weights for balancing. The wheel assembly is placed on a balancing arbor and special stand that reduces rotational friction to a minimum. The weights are shifted until balance is achieved.

After mounting on the grinding head spindle, the wheel must be trued or dressed. This is an extremely important step. The technique will vary depending upon the desired effect—fine finish, fast removal of stock, etc. Convenient attachments, rigidly mounted, are supplied for this operation.

Diamonds are the usual dressing tool and they should be applied to the wheel at an angle. If a pencil is used perpendicular to a piece of paper, the point soon dulls. Angular contact has a self-sharpening action and the principle applies to the diamond as well as to the pencil.

Depth of cut and traverse speed will greatly affect finish. Light cuts produce a finer finish and heavy cuts the opposite. Dressing starts in the center since most face wear is concentrated near the edges and in order to control the depth of cut, it should start at the high spot. Fast traverse produces a coarse, open finish while too slow a traverse will give a finish that is fine to the point of glazing and consequently will not cut as required. A good average rate of traverse is 5 ft. per min.

Radii on the wheel for the purpose of grinding fillets on the crankshaft are dressed with a special fixture (see illustration). The setting of the diamond with respect to the axis of swing determines the radius cut.

Considerable heat is generated by the dressing tool and it is important that the coolant be generously supplied. Excessive heat may damage the diamond mounting. The coolant should be turned on before dressing starts because if the diamond is heated and then the coolant applied, it may crack.

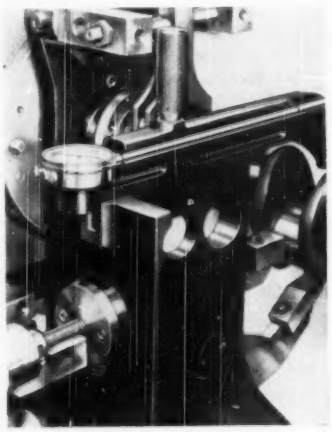
Wheel balance is important in dressing. Even though the original balance is correct, temporary unbalance may be caused by the coolant flowing over one side of the stationary wheel or settling to the bottom of the wheel after previous use. The coolant should be turned on and the wheel allowed to spin until balance is restored. It is also good practice to allow all moving parts to attain their normal operating temperature before precision work is attempted.

Steady Rests and Measurement

Grinding is a cutting operation requiring pressure at the point of wheel contact. Some means of support is desirable, particularly in the case of long shafts, and steady rests should be used whenever possible. One is always required to support and back up the journal being ground. In this way, downward deflection or spring away from the wheel is eliminated.

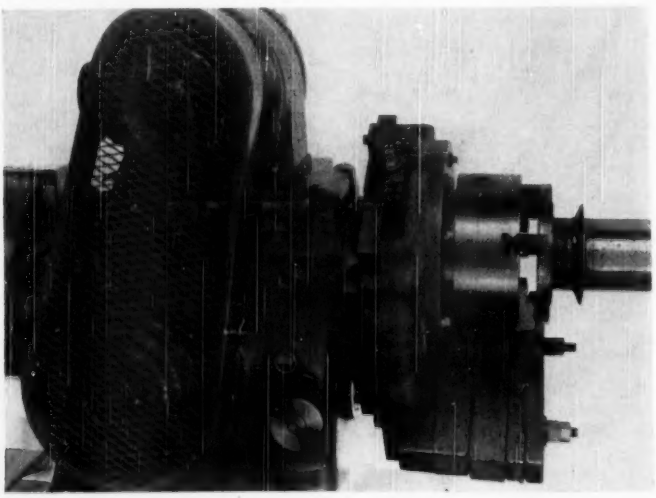
Proper operation of the steady rest is very important in obtaining straight, round surfaces. Grinding is first started without the shoes in contact. When the grinding cut extends from one half to three quarters of the bearing circumference, the adjusting screws are turned to bring the lower shoe into firm contact and the shoe opposite the point of wheel contact into position to absorb the pressure of the wheel without allowing or creating any spring. The "feel" for proper operation comes from experience.

Accurate and continuous check on dimensions is maintained very conveniently by using an Arnold gauge. A hydraulic mounting attached to the wheel guard supports the weight of the gauge and permits the necessary movement. A provision for lateral movement, parallel to the surface being ground, permits rapid checks for taper or diameter measurement.



Special dial gauge mounted on steady rest for conveniently checking run-out during mounting.

Headstock with chuck gripping on flange of shaft. Note slide arrangement for offsetting shaft and method of attaching counterweights.



Grinding

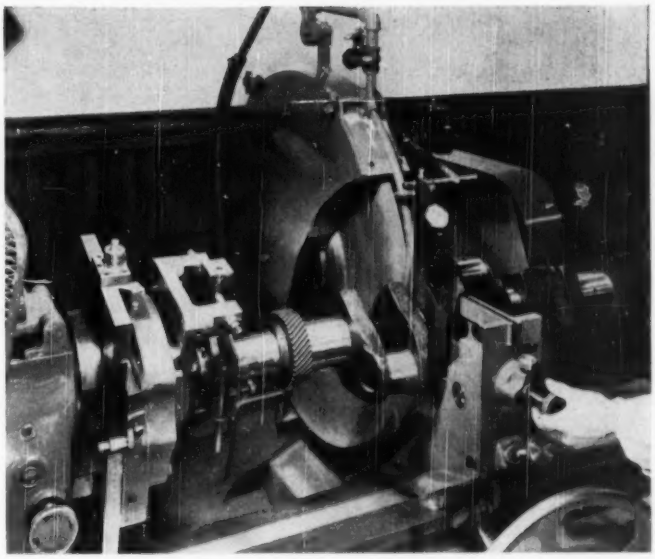
Smaller shafts sometimes permit the use of a wheel the full width of the journal to be ground. Wide wheels, however, tend to glaze more rapidly, deform the shaft and make steady rest operation more difficult. Narrower wheels and plunge cuts are more commonly used.

Several plunge cuts are preferable to a single plunge and then traverse because during the lateral movement the edge of the wheel is doing all the work and more frequent dressing is necessary. Usually the width of wheel

is such that two or three plunges will cover the area. A light traverse cut (0.0005 in.) is then made to insure continuity of surface.

Recommended feeds and speeds associated with general grinding practices lose their importance in crankshaft regrinding. One reason is the limitation on the turning speed of the work as the result of its conformation and the complexity of obtaining balance at the higher rpm. Workhead speeds are limited to 20, 40, and 60 rpm. In general, the larger the shaft, the slower the speed. Here again, practice is the best means of selection with the machine builder's recommendations, balance conditions, etc., matters for consideration.

The action of slowing the work speed makes the wheel act harder and vice versa. With respect to the surface



Shaft mounted on centers and driven by dogs. Note screws for locating and locking dog tail without placing any torque on the shaft after one dog is set. Steady rest is in place and Arnold gauge is located on journal to indicate diameter.

Fixture for dressing radius. Ramp of gauge is calibrated for easy diamond setting to cut radius desired.

speed of the wheel, a decrease as will be caused by a reduction in diameter will make wheel action appear softer and an increase in the surface speed, harder. Grinding "soft" is evidenced by the necessity for excessive trueing whereas "hard" grinding will load up the wheel with metal particles.

Fillet grinding is somewhat controversial. The original radius is generally reduced during regrinding and it is a question of how far one can go before the purpose of the fillet is destroyed. Experience tends to show that the necessary reduction is not harmful. Contour of the fillet may be produced as mentioned by dressing the wheel but considerable valuable abrasive material is lost in the process. Sometimes the contour is reproduced on a portion of a broken wheel and the fillet ground "free hand."

Chatter and Burning

Chatter marks are the nightmare of the operator. They appear as lines parallel to the axis of rotation. They are generally the result of vibration either from external sources or from the machine and work itself. Looseness of fits; misalignment; improper mounting or balance of the work; wheel unbalance or improper selection; and faulty lubrication are some of the possible causes. For good and chatter-free finishes it is essential that the cause be found and corrected.

Burning is the result of excessive heat created at the point of grinding. It may be visible as a heat color on the surface or lay below the surface. Such heating will destroy the hardness of the shaft and in extreme cases of localized heating, result in minute thermal cracks. One common cause of burning is the practice of turning off the coolant when traversing near the fillet in order to improve visibility. While convenient, the practice should be avoided.

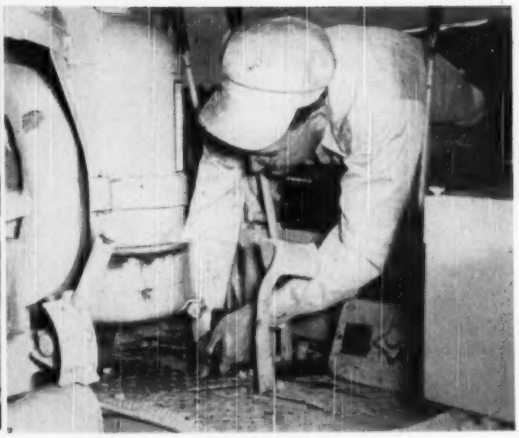
Other common causes are excessive surface speeds or feeds; too fine a wheel finish, producing glazing; and lack of or inadequate coolant.

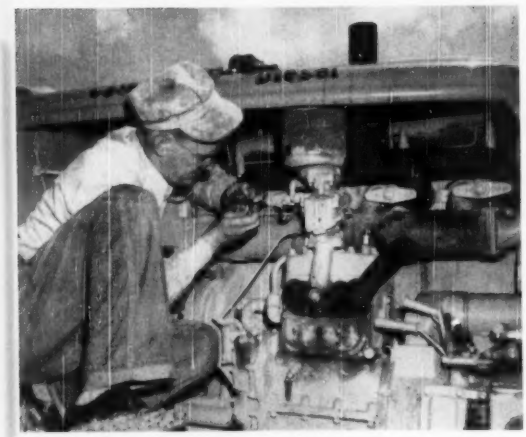
General

It can be seen from this discussion that regrinding is a complicated and exacting process. Fortunately, continual practice and the acquired know-how make it a fairly routine procedure that becomes practically second nature to a good operator.

Modern regrinding machines are built with sufficient inherent rigidity and accuracy to permit a good job to be done providing that attention is given to the various items discussed that fall within the province of the operator.

It now remains for the user to specify the exact dimensions required on the shaft—whether the shaft is to be ground below the nominal undersize diameter to provide bearing clearance or to the full undersize diameter with the bearings bored to provide the clearance. The reground shaft is then, for all practical purposes, the equivalent of a new one.





Tractors Thrive With

PREVENTIVE maintenance is one of the keystones of good equipment performance. It is a rather simple thing, made up primarily of taking precautions to prevent serious damage to the equipment because of breakdowns. Letting preventive maintenance slide can lead to equipment failures which will cost the operator money in repairs and unavailable equipment.

Preventive maintenance consists of four separate considerations:

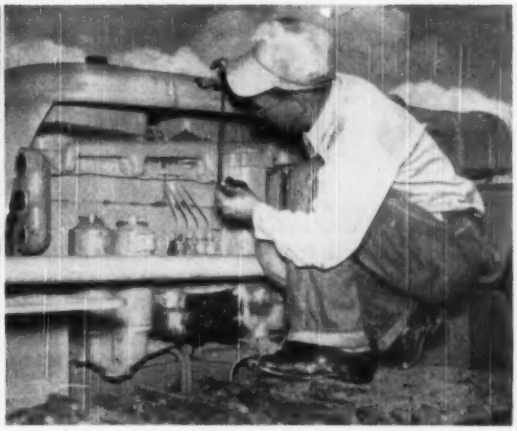
1. Adjustments to take care of normal wear.
2. Proper lubrication of working parts.
3. General tightening of bolts, nuts and capscrews and minor parts replacement.
4. Stopping all foreign matter from getting in to working parts.

If these four things are accomplished, you can be sure that your equipment will give good service.

Specifically, preventive maintenance includes continuous attention to the supply and use of proper lubricants. Inspection and cleaning of air cleaners. Checking oil levels and pressure gages. Periodically draining certain compartments and performing miscellaneous jobs such as removing frozen mud from track carrier rollers or cleaning trash from in front of the radiator to insure trouble-free operation.

All these things are small jobs. Because of the ease with which they can be accomplished, it is essential that a record be kept of every inspection and check, otherwise the maintenance man or operator will not know when he last checked his oil level or when the air cleaner element was last washed.

(clockwise) Various preventive maintenance operations. Operator checks lube filter, crankcase oil level, air cleaner cup which catches heavier particles passing through cleaner and flywheel clutch adjustment. These simple precautions pay off in better performance and longer equipment life.



Proper Maintenance

In an operation involving several pieces of equipment, this business of keeping records becomes even more important. So, if you're going to set up a preventive maintenance program, put records and record forms (make them as simple as possible) at the head of your list. Also, in large operations, make one man responsible for the program to avoid difficulty and write out all instructions for the program.

Another basic requirement for an effective program is good mechanics. Men who know the "how", "when", and "why" of preventive maintenance are infinitely better than those men who have no understanding of preventive maintenance.

To records and good men add proper tools and facilities, and the program is all set to go. Manufacturers generally supply a set of tools with the machine. These tools will take care of anything that may come up in preventive maintenance. A clean place to work is also essential so that no foreign matter enters the engine during maintenance.

After your program is set up or, if you already have a program, ask yourself these questions: Who has the primary responsibility? Why and how does the job have to be done? What tools must be provided to do the job? What assurance is there that the job was done at the proper time?

If you can answer all the above questions, you have arrived at the basis of a maintenance program which will assure increased production and economy through less "down-time", lower operating costs and small repair bills.

(clockwise) Operator checks tension and condition of fan belts, inspects fuel filter on starting motor, checks air filter on fuel tank cap and removes air filter screens prior to cleaning them. All photos on these pages were supplied through the courtesy of the Caterpillar Tractor Company.

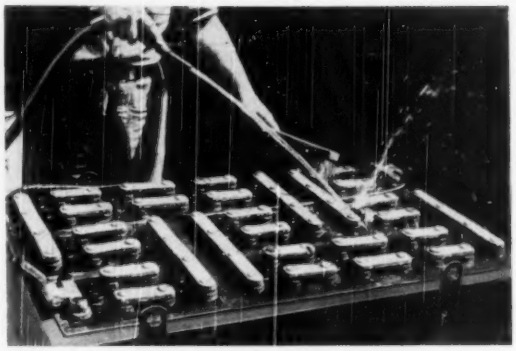
Shop Repair and Reconditioning of Storage Batteries

*by S. K. Lessey**

ORDINARILY, lead-acid batteries require no repairs during their life except those resulting from accident. There are, however, a number of practices and precautions that should be observed to insure maximum service life. There are also established procedures and handy tooling available for such repairs as might be required. Attention to these matters will insure long and satisfactory battery life.

Precautions should be taken when shopping batteries to keep the trays of each battery together. The cells are designed to wear out equally and in order to keep them properly balanced, they should be of the same size, age and condition. In general, replacements should be made of complete batteries instead of individual cells.

Batteries sent to the shops for inspection and reconditioning should also be tested to see they are capable of giving satisfactory service. However, they must not be condemned until tests have proven them unserviceable.



Washing a battery with a hose using a wooden handled brush to avoid possibility of shorts

Cell connectors being removed with Exide's screw type puller prior to cover or jar replacement.

Following removal of the cell connectors, the seal nuts are removed with a special wrench.

Inspection

On receiving a battery in the shop it should be examined to determine what repairs are required. The inspection should be carried out in the following manner and order.

1. Clean battery by washing with a hose; also wash vent plugs by immersion in water and examine gas escape holes for clogging.
2. Add approved water to the cells, where necessary, to bring the electrolyte level in all cells to $\frac{1}{8}$ in. below the bottoms of the filling tubes in the cell covers.
3. Carefully examine for evidence of breakage all containers, trays, jars, covers, sealing compound, terminals, connectors, and vent plugs.

*Manager, Service Division
The Electric Storage Battery Co.

Replace any leaky containers or jars, but make no further repairs until battery has been found serviceable.

4. Determine if a specific gravity adjustment is required by giving the battery an equalizing charge as described below.

Equalizing Charge

Acid or high gravity electrolyte should never be added to the cells without first making sure that charging will not restore the gravity to normal. Therefore, a battery should first be given a thorough equalizing charge to determine the full charge gravity of all cells. When charging, it is best to charge *a little longer than not enough*. A complete record should be kept on a battery test record form (see illustration).

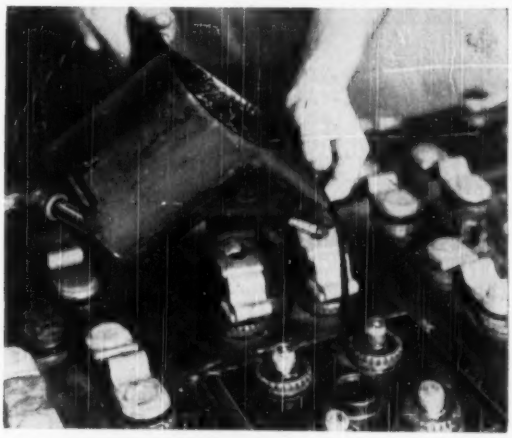
1. Read the specific gravity of each cell and record in column headed "Before Test." Then place battery on charge at the finish rate of charge as shown on the nameplate or instruction book for the particular battery. If considerably discharged, the charge may be started at two to three times the finishing rate and *reduced to the finishing rate when voltages reach 2.40 per cell.*
2. About one hour later while charging at the finishing rate, start taking hydrometer and voltage readings of *all cells* and the temperature of two. Use the two cells showing the highest and the lowest specific gravity for taking thermometer readings. Record all readings every three hours on the battery test form.
3. Continue the charge, taking readings of all cells every three hours, until three consecutive readings of each cell show definitely that the specific gravity and voltage of all cells have reached a maximum and will rise no further.

The equalizing charge may be interrupted, but should be continuous while the last three sets of readings are being taken. If the charging rate used is lower than the finishing rate, increase the time period proportionately. If charged overnight, unattended, the rate should be set at no more than one half the finish rate.

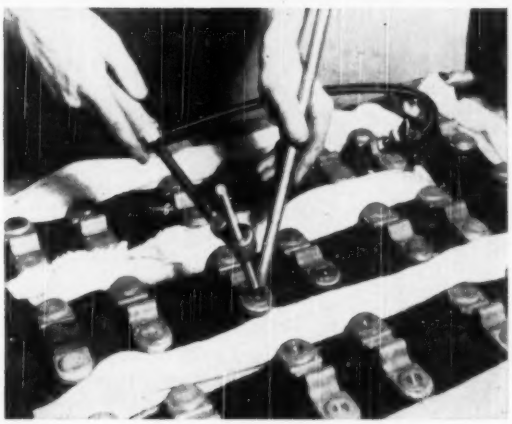
Hydrometer readings should be corrected to 77 deg. F. Add 1 point (.001) for each 3 deg. that the ambient temperature is above 77 deg. F. and subtract 1 point for each 3 deg. below 77 deg. F.

If the specific gravity of any cell is lower than that specified on the nameplate or in the instruction book for the particular battery, the specific gravity of the low cells should be adjusted to normal.

Pressing glass caulking cord into bottom of sealing groove as step in resealing cell.



Electrically heated ladle pours hot sealing compound over caulking cord in sealing groove.



Reburning cell connectors with Exide's carbon burning outfit. Note damp rags covering vents.

Adjusting Specific Gravity

Put the battery back on charge at the finish rate or higher so that the

cells gas heavily. Remove the electrolyte from the low reading cells down to the splash cover level. Replace with a specific gravity not more than 50 points higher than the normal full charge gravity of the battery.

For example, with a normal full charge gravity of 1.250, use 1.300 gravity electrolyte; with a normal full charge gravity of 1.275 use 1.325 gravity electrolyte, etc. The electrolyte used in making gravity adjustments should be of suitable quality.

Wait at least one half hour for the added electrolyte to mix thoroughly in the cells and then take a gravity reading. If still below normal, repeat the process as many times as necessary to restore gravity to normal. Each time wait at least one half hour for the added electrolyte to mix in before taking hydrometer readings. (*Make sure battery is on charge and gassing heavily during this process.*)

Should the specific gravity accidentally be raised above the desired maximum, when corrected for temperature, withdraw a small amount of the electrolyte and replace with water—repeating at hourly intervals if necessary until the desired reading is obtained.

After this adjustment has been completed, record specific gravity (corrected) of each cell in the column headed "Finish of Equalizing Charge and Gravity Adjustment."

Wash the battery thoroughly with a soda solution to neutralize any spilled electrolyte.

Capacity Test

Capacity tests are required after reconditioning if there is doubt of the battery's ability to operate satisfactorily when returned to service. The capacity test should be conducted in the following manner:

1. Test should be made within one day after specific gravity adjustment has been completed. Otherwise, see that the battery is fully charged.
2. The capacity test may be made at the 3, 5 or 8-hr. discharge rate. The 5-hr. rate is usually preferred. Tables of discharge rates or the tables of ratings may be found in manufacturers' catalogs.
3. Before starting the test, read the specific gravity and voltage of each cell on charge at the finish rate and record in the column headed "Before Test."
4. During the capacity test the discharge rate must be held constant. A record of the test should be made on the battery record card.
5. Start the capacity test.
6. Read and record voltage of all cells and temperature of two cells at the end of 2½ hr. or when the capacity has been reduced 50 per cent.
7. At the end of 3 hr., 15 min., again take voltage readings of all cells and temperature of one or two cells.
8. At the end of 4 hr., or 80 per cent capacity reduction, take voltage readings of individual cells and total voltage of all cells in series and stop the discharge. If the cells at this time average 1.75 volts, the battery has a capacity of 80 per cent and is serviceable.
9. After the capacity test is completed, read the specific gravity of each cell and record in the column headed "Sp. Gr." under "Last Reading."

Replacement of Broken Covers

To replace a broken cover, remove electrolyte down to splash cover. (*Blow into cell under repair to remove explosive, gaseous mixture and cover other cells with a wet cloth.*) Remove the cell connectors and then the sealing nuts with a special wrench for this purpose.

Unseal cell by running a hot putty knife through the sealing compound close to the inside of the jar or container. Cut through the compound, but be careful not to go down too far or the top edges of the separators may be damaged. Next, remove the broken cover.

Remove all sealing compound adhering to the jar or container walls with a hot putty knife. Neutralize with a soda solution; wipe dry with a clean cloth and use a soft flame to remove all traces of moisture.

Wipe the seal surfaces of the new cover with a clean cloth and place it in position. Replace rubber gaskets and sealing nuts. (Before replacing seal nuts, the old No-Ox-Id grease should be cleared from the seal nut grooves.) Tighten seal nuts and center punch them at three or four points to prevent them from backing off. Press glass caulking cord into the bottom of sealing groove. Then pour melted compound into the groove in two steps—by first pouring the groove half full and soft flaming until the compound can be seen adhering to the jar walls and cover; next fill the groove and soft flame again. Using a putty knife clean away any compound that overflows or spills on top of the covers.

Do not overheat the sealing compound. For best workmanship and seal, the sealing compound should be heated to the temperature specified for the particular compound used. For example, Exide's No. 206 compound should be heated to and poured at a temperature of 425-455 deg. F. Thermostatically controlled compound melting pots, to heat and maintain the compound at the desired temperature, are available, as are electrically heated pouring ladles. A batch or pot of sealing compound should not be kept hot more than a total of 24 hr. If heated or kept hot for a longer period, discard and use new compound.

Renew the No-Ox-Id grease by melting and pouring it in the wells at the tops of the sealing nuts and replace the electrolyte and connectors.

To Replace a Broken Jar or Container

Remove the cell connectors. (*Blow into cell under repair and cover other cells with a wet cloth.*) Unseal cells as

CHARGE—DISCHARGE, BATTERY TEST RECORD

Type and Size _____ Shops _____ Time Test Started
Mfgrs. Serial No. _____ Owner's Serial No. _____ R. R. Charge _____ A.M. P.M.
Electrolyte Level - Inches Above Splash Cover _____ Date New _____ Discharge _____ A.M. P.M. Date _____
Sediment _____ Inches

Time	1st Reading AM	1st Reading PM	2nd Reading AM	2nd Reading PM	3rd Reading AM	3rd Reading PM	4th Reading AM	4th Reading PM	5th Reading AM	5th Reading PM	6th Reading AM	6th Reading PM	Last Reading AM	Last Reading PM	Finish of Equalizing Charge and Gravity Adjustment	
Total Batt. V.																
Temp. Cell No.															Temp.Cor. Sp. Gr.	Volts
Rate - Amps.																
Cell No.	Before Test Volts	Before Test Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.	Volts	Sp.Gr.
1																
2																
3																
4																
5																
30																
31																
32																

REMARKS:

A shortened version of Exide's suggested Battery Test Record Form.

in replacing a broken cover. The cover should not be removed if it is in good condition.

Examine the negative plates carefully. If they have become partially dry due to a cracked jar or container, new negative groups should be supplied. Dried or partially dried negative plates should not be re-used. If the negative plates are in good shape, examine the element for damaged separators and replace any that may be cracked or broken. This may be done by laying the element on the side with the lower end hanging over the edge of the bench.

Do not allow the negative plates to dry out or heat. If they show a tendency to heat, sprinkle with water until the element is back in the container and covered with electrolyte. *(If jar or container is not readily available keep element immersed in electrolyte of any specific gravity between 1.150 and 1.200, in a non-metallic vessel.)*

Press on the outside negative plates and install the element in the new jar or container. Reseal the cells as described before and replace the connectors. Return the old electrolyte to the cell. If this has been lost, fill the cell to the correct level with electrolyte of the same specific gravity as that in the other cells. Give the cell an equalizing charge and adjust the specific gravity as mentioned previously.

Terminal Corrosion

To correct and effectively prevent terminal corrosion, open the corroded connection and clean completely. If pitted, smooth the contacting surfaces, wash with a bicarbonate of soda solution to neutralize any acid, and dry thoroughly. Before making connections, all terminals or surfaces to be bolted together should be made clean and bright and coated with a film of No-Ox-Id grease or pure vaseline, which should also be applied to the bolt studs. After all connections are made tight, surplus No-Ox-Id grease or vaseline that squeezes out should be removed.

Peace on Earth,
Good Health to Children
For the sake of your children, buy and use Christmas Seals.
Thanks to Seals, children today have a far greater chance of escaping TB than you did.
To give them a still better chance, send your contribution today, please.
buy Christmas Seals
Because of the importance of the above message this space has been contributed by

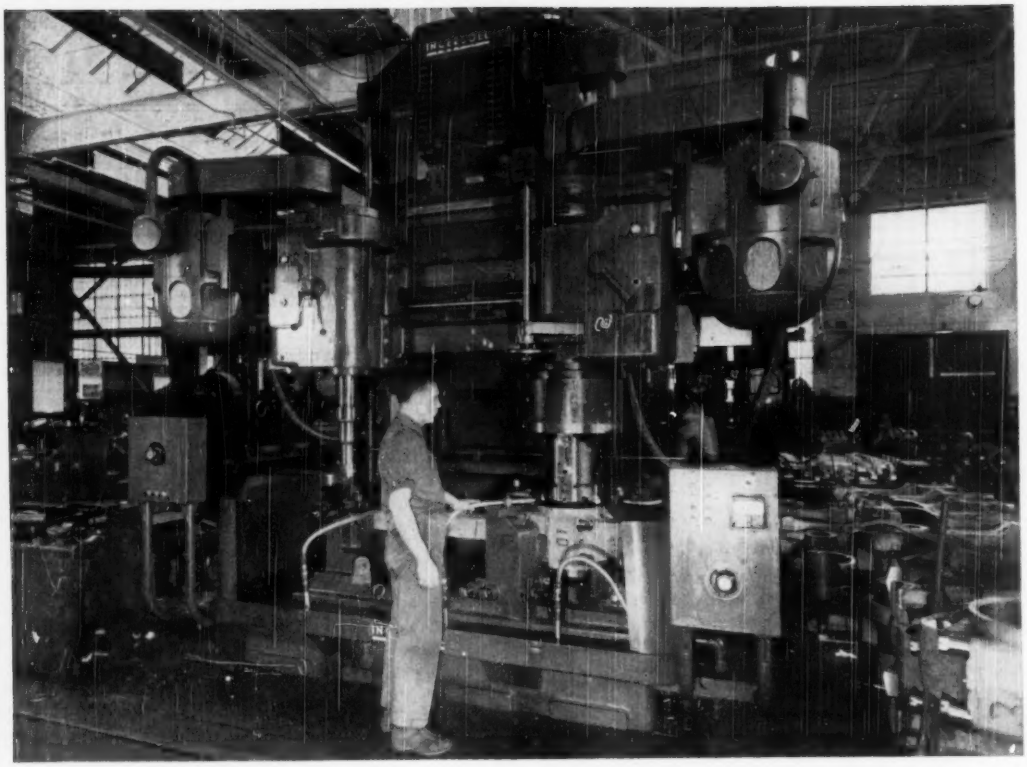
Maintenance of Spare Batteries

Charged batteries must be kept in such condition that they are ready for immediate service. They should be stored in a clean, cool dry place and kept clean and dry. Keep vent plugs in place at all times. When cells require water, add but do not overfill, just before charging.

At monthly intervals read the specific gravity. Charge the battery before the reading has lowered 30 points from the fully charged reading shown on the battery's nameplate. Frequency at which charges are required will vary with temperature, ordinarily between two to four month intervals.

When charging is required, it should be at the normal rate shown on the battery's nameplate. Continue the charge until all cells gas freely and until the temperature-corrected specific gravity of the lowest reading cell has risen to maximum and has shown no further rise for two consecutive hourly readings.

It is important that batteries be maintained at a high state of charge during cold weather to avoid the possibility of freezing. The electrolyte freezing point when standing idle on open circuit varies from 19 deg. F at a specific gravity of 1.100 to —62 deg. F at 1.250, and consequently damage from freezing can be avoided by keeping the batteries well charged.



Both crank-end and piston-end bores of a connecting rod for a type GMW Cooper-Bessemer compressor being machined simultaneously.

Special Tooling Helps Production

NEED for special tools is not confined to maintenance men and operating engineers. Engine manufacturers must have them to produce units which will meet the high standards set by modern engine requirements. These tools, of course, cost a lot more than the wrenches, etc., required by the maintenance men but investment in them has enabled the engine builders to step-up the operating efficiencies and service life of gas and diesel engines.

On heavy equipment particularly, vital engine parts from the smallest screws weighing but a few ounces to the largest operating units, such as connecting rods and crankshafts, are today being machined to watch-like tolerances. Precision machining limits, heretofore restricted principally to only the finest machine tools, are now being applied production-wise to finishing key engine parts wherever engine operating efficiency can be improved, engine life increased, or part interchangeability further assured.

New developments in both tooling methods and machine tools have, of course, been responsible for some of the progress made in engine performance. The progressive attitude of engine builders who are spending large sums of money for shop equipment in spite of inherent sales uncertainties in the heavy engine industry is another important factor in these improvements.

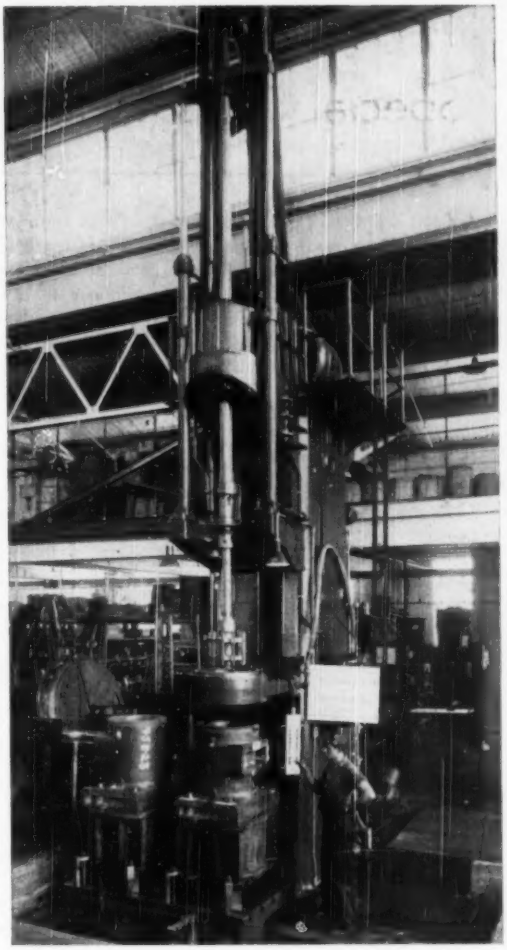
Persistent efforts to achieve engine perfection are paying off. In recent years, heavy engine builders have been able to make substantial gains in improved wear resistance on major engine parts. Translated into over-all engine life, this has meant appreciable and continued savings in engine operating costs.

The net result to the engine building industry has been a constantly increasing preference for internal combustion engines for pipe line transmission work, electric power generation, locomotive and marine service. By making heavy capital expenditures to secure the best, most efficient production equipment, engine builders have made it possible to offset a greater part of today's rising labor costs which might otherwise have priced some heavy engine equipment out of the market.

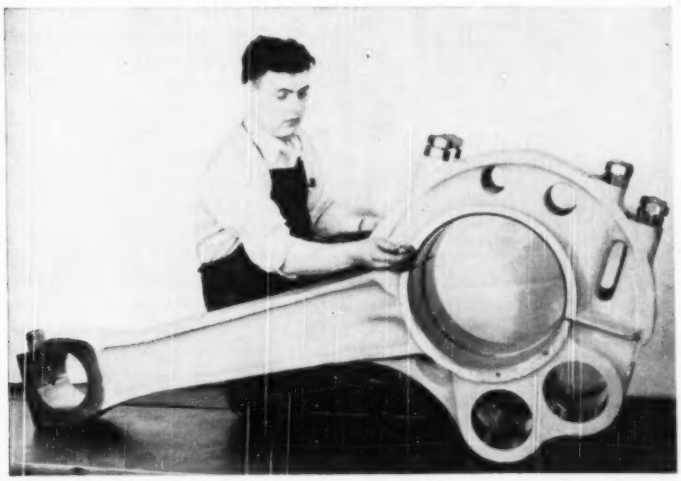
A typical example of modern engine building trends is illustrated in part by an unusual retooling project at the Cooper-Bessemer Corporation's plant in Grove City, Pa. To machine the bores in the connecting rod of the Cooper-Bessemer 2500-hp. Vee type GMW compressor, the firm recently installed a mammoth vertical boring machine weighing over 105,000 lbs. and costing more than $85,000.

The principal significance of this project is that by installing the machine, it was possible for Cooper-Bessemer to save 12 hours machining time per connecting rod. Allowable machining tolerance as determined by the engine research men as necessary to achieve certain engineering advantages required a total of 13 hours of machining using conventional shop equipment. With the new machine, greater piece-to-piece accuracy was obtained in a time of only one hour per rod.

Accuracy of hole spacing in the 1700-lb. tough, cast alloy steel rods is held to 0.001 in. The holes themselves must be kept within plus or minus 0.001 on diameter or out-of-roundness. Of greatest importance is the parallelness of the bores. The axes of the holes must be parallel within 0.001 in. in 10 in. of their length. This feature is necessary to eliminate any undue side thrust of the piston on the cylinder wall that would create excessive wear and reduce engine component life.



Cooper-Bessemers specially built vertical honing machine for finishing cylinder bores up to 24 in. diameter.



Master connecting rod for the type GMW engine-driven compressor. Bores are parallel to 0.001 in. in 10 in. of their length.

Another production machine is one designed to hone the walls of cylinder livers in which pistons up to 24-in. diameter must reciprocate. Since no such hone was available for doing the type of work to the degree of surface quality and size needed, Cooper-Bessemer constructed a special machine which cost more than $25,000.

Much of the pioneering and development of American engine builders is naturally taken for granted these days. Yet, without a constant striving for perfection, the high standards of modern engines would today be impractical or impossible. It is upon this industry that many other industries depend for reliable, low-cost power.

Special Tools Help Maintenance Programs

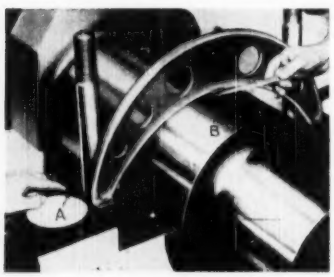
WHILE a diesel engines does not necessarily require any special maintenance tools, a set of tools specifically designed for certain jobs can make the maintenance program of a plant or shop much easier. Practically every engine manufacturer makes or recommends some special tools which can be a big help to the maintenance man. These tools are usually inexpensive and quickly pay for themselves in time and labor savings.

Tools will vary with the size of the engines for which they were intended. In the case of the smaller engines, many of the special devices have been adapted from automotive practice. Larger engines are a different matter, being more individual in their requirements and most of the engine builders in this category have developed special tools for their own line of engines. For purposes of this article, Nordberg has been selected to illustrate the nature and functions of such tooling as applied to large engines.

Bearing and Crankshaft Tools

One of the most important parts of a maintenance and repair program is that devoted to the bearings and crankshaft. Several tools for inspecting and checking these parts are available. One of these tools is the crankshaft bridge gauge. This gauge is used to measure main bearing wear after the engine is in service and to check alignment of the shaft.

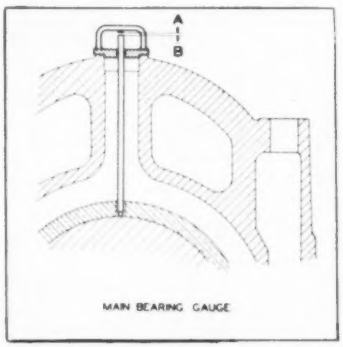
Crankshaft bridge gauge in use.



To measure wear, the bearing cap and upper half of the bearing are removed. The gauge is placed on the bedplate and a reading is taken at "B" (see illustration) by inserting a feeler gauge between the crankshaft and the boss on the gauge. A reading is stamped on the bedplate of the engine in the factory and the variation from this reading will show the amount of wear.

If the readings taken by the operator differ by more than four or five thousandths from each other, a misalignment condition exists and the "offending" bearing must be replaced. This gauge indicates whether or not all bearings are wearing uniformly and, when the amount of "wear down" is at the limits for the particular engine type, new bearings should be installed.

Running clearances on the main bearings can also be checked with a special tool called the main bearing gauge. This is similar to the bridge gauge except that the bearing cap acts as the bridge.



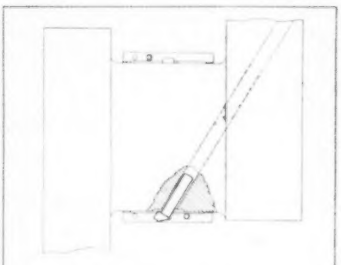
MAIN BEARING GAUGE

The gauge sits on top of the oil supply hole in the cap and a rod passes down through the hole and through the oil hole in the main bearing. The proper distance between A and B (see illustration) is known and the variation between the established clearance and the clearance measured indicates the amount of wear in the bearings.

A distortion gauge can also be used to determine shaft misalignment. It can be used without removing engine parts, a distinct advantage.

The distortion gauge is inserted between the crank webs of the engine at a point as far away from the crankpin as possible. The engine is rotated with the barring gear, taking care that the con rod does not strike the gauge. Readings are taken every 90 degrees. The readings indicate the amount of shaft flexing, a measure of misalignment. An inside micrometer will also do the job.

Another handy tool is one designed for removing main bearing shells. This

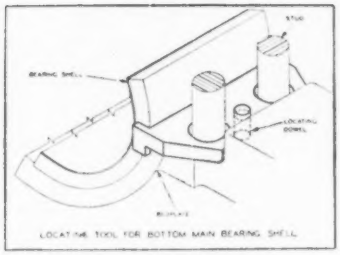


TOOL FOR REMOVING MAIN BEARING SHELLS

tool is inserted in the drilled oil passage in the crankshaft (see drawing). The tool has a small flat extension on the end which, as the engine is barred over, catches on the bearing shell and forces it to turn with the shaft. The bearing turns until it unseats itself and can be lifted out.

In using this tool, you must be careful that the extension does not go beyond the bearing shell or it will catch on the lower bearing saddle and snap off, plugging or damaging the oil hole. Using this tool, it's a cinch to remove the lower bearing shells, but without it you have a real project.

Another tool made available by Nordberg is a locating tool for unflanged bottom main bearing shells. When installing the bottom shell of a main bearing, the tool (see illustra-



LOCATING TOOL FOR BOTTOM MAIN BEARING SHELL

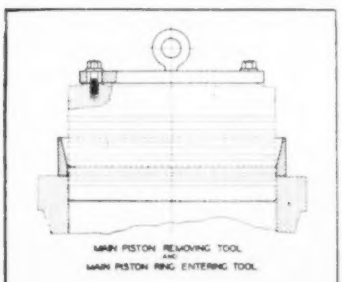
tion) drops down over the two studs and the locating dowel. Two "arms" on either side of the tool extend beyond the bearing shell and serve to properly locate it when it is rolled into the bearing saddle. By using this simple rig, it is very easy to properly locate the bearing.

Improperly seated bearings will cause a lot of trouble. Oil holes will not line up properly with the result that there will be no oil to lubricate the shaft at the mains. A bearing that laps over the end of the saddle will restrict shaft end play and the steel bearing back may rub against the cheek of the crankshaft causing undue wear on the shaft. Another consideration is that the two halves of the bearing will not properly meet with the result that the bearing will not function properly.

Reciprocating Assembly Tools

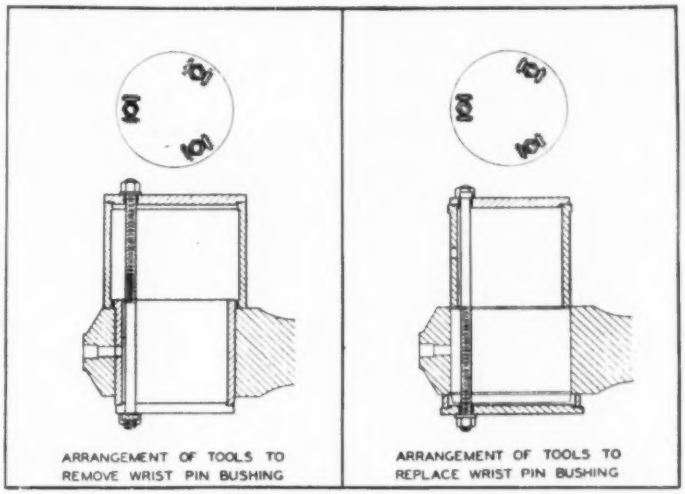
In order to avoid ring breakage when inserting heavy pistons in the cylinder, a piston ring entering tool can be used. This tool serves as a guide for the rings and compresses them when the piston with its rings is inserted in the cylinder.

The illustration shows the piston ring entering tool and also the piston removing tool. This latter is simply a bar with a female socket attached to the center and two bolt holes at either end of the bar. Bolts are put through the two holes and screwed into the tapped holes in the top of the piston. The piston can then be removed using a block and tackle or chain hoist.


MAIN PISTON REMOVING TOOL AND MAIN PISTON RING ENTERING TOOL

Wrist pin bushings can be removed and replaced with the use of a very simple rig, illustrated here. The "special tool" consists of two plates, a spacing collar and three nuts and bolts. In use, one of the plates, slightly smaller in diameter than the bushing is placed on one side of the con rod eye. The collar, slightly larger in ID than the OD of the bushing is put on the other side of the eye with a plate on the top of the collar. The three bolts are passed through the holes in the plates and the nuts tightened, forcing the bushing out. To install a bushing, the process is reversed.

When installing a bushing, the chief thing to watch is that the bushing is not cocked since inserting the bushing when it is cocked will damage it. It is also important that the oil holes index properly to insure proper lubrication.


ARRANGEMENT OF TOOLS TO REMOVE WRIST PIN BUSHING

ARRANGEMENT OF TOOLS TO REPLACE WRIST PIN BUSHING

Injection System Tools

A quick way to test your fuel oil line for leaks is provided in the test plug for fuel oil lines. The fuel oil line is attached to the nozzle tester and the pump is stroked until the line is full of oil. The plug is screwed on to the line and the pump is stroked until the proper pressure is reached. Oil leaks will show up by using this method since the pressure built up in the line will cause the oil to leak and faults in the lines will be located.

Another handy tool is the fuel pump priming lever. This is especially useful after the fuel pump has been repaired or replaced.

When a fuel pump has been taken off an engine it must be primed and the fuel lines bled to remove all air pockets or bubbles after the pump has been installed on the engine. If this is not done, it is possible that no fuel will be injected into the cylinder from the pump or that it will take some time for fuel to be properly injected.

To avoid these difficulties, the fuel pump priming lever is used to prime the pump. This tool duplicates the action of the cams on the camshaft of the engine in actuating the fuel pump plunger. By attaching the lever to the fuel pump and actuating the pump plunger, fuel is delivered to the pump and fuel lines independent of engine operation.

When a full flow of fuel starts to come out of the fuel line, the operator knows that his line is full of fuel and that there are no air bubbles or pockets in the line. After getting full flow, he attaches the line to the injector and starts his engine.

Other Tools

When checking for cylinder liner wear, a useful tool is a trammel for locating the inside micrometer to measure wear. This trammel drops into the liner (see illustration) and drilled holes in the trammel locate the points at which measurements should be taken.

The measurements obtained can be compared with those given by Nordberg in the "cylinder liner data sheet" for an indication of the amount of liner wear. The operator can then determine if his liner wear is excessive and take the necessary corrective action.

When tearing down or erecting an engine after overhaul, a tie rod jack should be used. This is available from Nordberg on a loan basis.

This tool is especially useful in these two operations because it makes it quite easy to assemble or tear down an engine. Without it, the tie rod nuts must be sledged to remove or install them and it is very difficult to get even loading on all the bolts.

The illustration shows the tie rod jack in use. The jack is screwed on the tie rod after the nut has been screwed on the rod. By building up the proper hydraulic pressure with the hydraulic pump the tie rod is "stretched" and the bolt can be tightened with comparative ease. When the tension is removed from the tie rod, the bolt is much tighter than it would be if the jack were not used. By using the same pressure on all bolts, uniform tension of the bolts is achieved.

In tearing down the engine, the same procedure is used and the jack actually lifts the nut off the block by "stretching" the tie rod and makes it easier to remove the nut. Use of the jack prestresses the bolts and helps to relieve the stresses in the engine frame and cylinder.

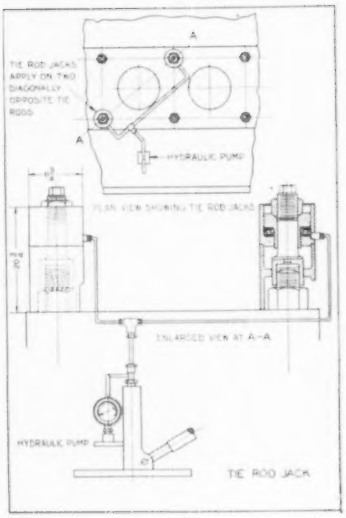
Safety Devices

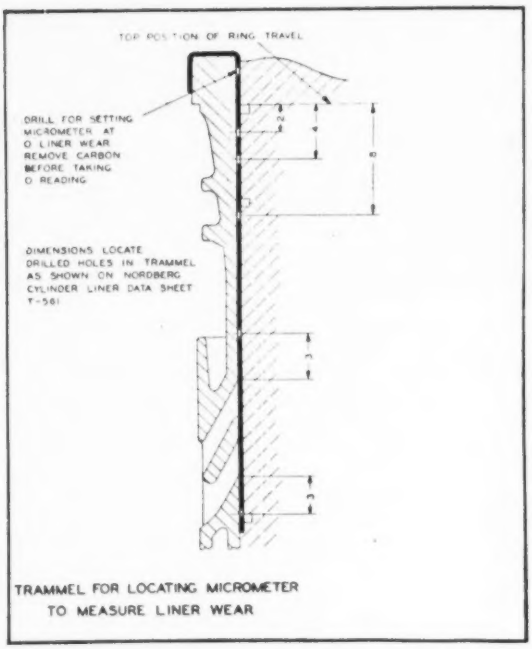
Several protective and safety devices are available. Two of these are a cotton belt for protecting the liner from damage and wrist pin guide nuts.

The woven cotton belt protects the cylinder liner from damage when the con rod slaps against the liner when the engine is barred over with the piston removed. The sock will protect the liner against scoring or other damage.

The wrist pin guide nuts serve to protect bolt threads and as a guide when making up a piston with the engine assembled. In some engines, it is necessary to slip the piston down into the cylinder and secure the piston pin to the piston. To do this, bolts are screwed into the tapped holes in the lower half of the piston and the guide nuts are screwed on the bottom of the bolts.

After the piston has been put into the cylinder and the bolts have properly entered the holes in the wrist pin, a cap must be put on the lower side of the wrist pin. Bolt holes in this cap must index with the bolts extending through the wrist pin from the piston. The wrist pin guide nuts again serve to properly guide the lower cap holes on to the bolts.




TOP POSITION OF RING TRAVEL
DRILL FOR SETTING MICROMETER AT O LINER WEAR. REMOVE CARBON BEFORE TAKING O READING
DIMENSIONS LOCATE DRILLED HOLES IN TRAMMEL AS SHOWN ON NORDBERG CYLINDER LINER DATA SHEET T-561

TRAMMEL FOR LOCATING MICROMETER TO MEASURE LINER WEAR

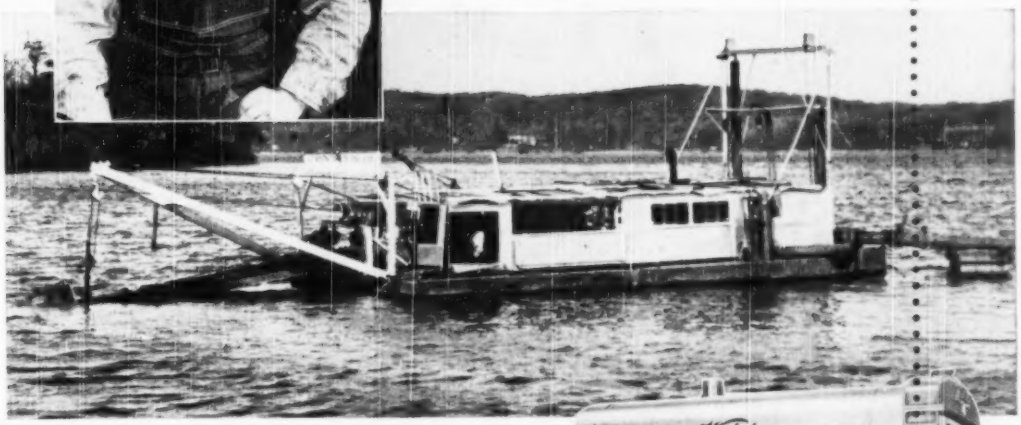
Numbers indicate distances (in inches) to locate points at which wear is measured.

Conclusion

Only a very few of the special tools which are available to the maintenance man and operating engineer have been described in this article. In most cases, especially in the case of large engines, all these tools are provided when the engines are delivered. If you don't have tools of this nature, it would be a good idea to contact your engine manufacturer's representative and inquire about the availability of tools such as these. They can save you a lot of time and trouble in your maintenance program and will be well worth having as you will see after you've had them in your shop for a short time.

MAKING A MARSH INTO MONEY

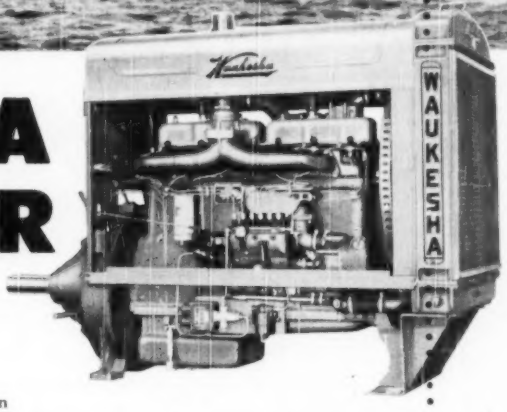
...with a Diesel driven dredge



WAUKESHA *Diesel* POWER

Model 148-DKU

Six cylinders, 5¼ in. bore x 6 in. stroke; 779 cu. in. displacement



Mr. VILBERT GUNYON looks pleased. Mr. Gunyon *is* pleased—with the way this dredge is filling in acreage on the shores of Lake Geneva, Wis. It is rapidly converting a marsh into resort property that is worth a million dollars or more.

The dredge is owned by the Gunyon Dredging Co., Elkhorn, Wis. It is the sand sucking type, and a 148-DKU Waukesha Diesel Power Unit drives both the pump and the cutter head. Mr. Gunyon is particularly pleased with this Waukesha Diesel. He thinks it's the best engine that he has ever run.

Installed in the dredge in the spring of 1946, this is one of the pilot models of the 148-DKU Waukesha Diesel. The unit in the picture shows the perfected design of the 148-DKU Diesel. It runs at full capacity with a remarkably clean exhaust. You'll be pleased, too, with a Diesel like this. It has a 7-bearing crankshaft with crankpins and main bearings hardened to 600 Brinell. Removable wet sleeve cylinders, hardened to 400 Brinell. Chrome silicon alloy intake and exhaust valves; both valve seats are Stellite inserts. 24-volt electric starting system. Why not find out all about it? Send for Bulletin 1414.

WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

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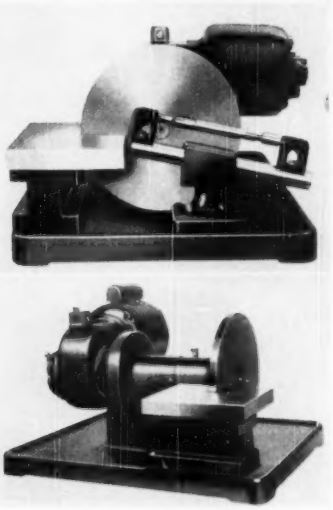
New Products



Lapping Tools for Finish and Accuracy

Products of the American Lap Company of Detroit have wide application wherever the fits and finishes produced through this process are required.

At the left is an internal lapping machine that is automatic in operation. Table travel is arranged for electrically timed reciprocation and motion is smooth throughout the cycle. Lapping compound is automatically supplied through the spindle and arbor to the center of the lap, insuring good distribution.

Helical slot laps and arbors are used with this machine. Both the internal diameter of the laps and the arbor are tapered. Lap diameter is increased by tapping it up on the arbor upon which, due to the helical slot construction, it "unwinds" and produces uniform expansion.

The surface lapping machine (upper right) may also be used for cylindrical work by modification as shown at lower right.

Machine Tool Accessories

The availability of two new machine tool accessories and improvement of one of their products has been announced by the Giddings and Lewis Machine Tool Company. The new products are an electrically operated positioning device and a face plate drive. The improvement is hardened and ground ways for horizontal boring machines.

The positioning device is said to provide automatic machine settings within 0.0002 to 0.0005 in. It is claimed that with this new device horizontal boring machine table and headstock fine feed movements to predetermined settings are mechanically controlled without resorting to time-consuming final hand adjustments. Designed as a standard accessory for table-type machines, equipped with saddle supports and auxiliary runways, the positioning device is equally efficient for use on a single workpiece requiring a series of bores, or on a number of parts produced in job lots, according to the manufacturer.

The new face plate drive is designed for the G & L Horizontal Boring, Drilling and Milling Machines for use in operations where increased power at lower speeds is desired. Tools, tool heads and special tooling set-ups can be rigidly mounted on the face plate, or it may be employed for holding and rotating the workpiece while tools are mounted on the machine table and fed by table movements. The face plate is 30 in. in diameter and equipped with eight radial T-slots on its working surface.

The hardened and ground ways now available on the G & L horizontal boring, drilling and milling machines are designed to insure continuous machining accuracy over extended periods of time. Two benefits are claimed for the hardening method, coupled with an advanced means of mounting the finished ways to the machine: unusual long wearing properties and minimized transmittal of torque strain and stress set up by temperature changes.

Cutting Tools

A complete line of adjustable reamers in carbon or high speed steel and a crew extractor set are now available from the Van Norman Co. The firm recently announced that it was placing these two new products on the market.

There are eleven different size reamers included in the new set. A special case is provided with the set so that the reamers can be properly protected when not in use.

The screw extractor set now gives Van Norman a complete line in this item. The new set (No. 62) includes five extractors in sizes most commonly used.

Permanent Antifreeze

Winterset, a 100 per cent glycol base permanent antifreeze is announced by Sepco, Inc. This product, according to its manufacturer, is boil-proof and one filling will last the entire winter.

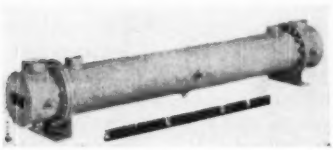
Formulated especially to meet heavy duty needs of automotive, bus, farm equipment and construction machinery cooling systems, it affords freezing protection far down into sub-zero

ranges. *Speconite*, a new chemical inhibitor, prevents rust and corrosion. When used in accordance with instructions, the antifreeze is guaranteed not to clog cooling system passages. It will not damage rubber hose. Also, it will not leak out of a cooling system that does not leak water. Extent of protection can be checked with a standard hydrometer.

Heat Exchangers

Specially designed shell and tube bundle heat exchangers for oil cooling in diesel locomotives, diesel engines, gasoline engines and similar applications have been announced by the Young Radiator Co. The new line which is said to provide high cooling capacity within a light-weight, compact shell is designated as "A-300."

The manufacturer says that the units are well suited for use with engine

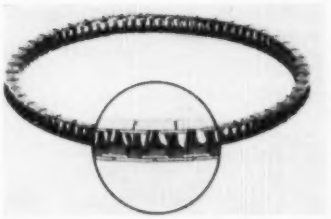


jacket water as the coolant, maintaining a balanced temperature between oil and water when required. The bonnets, designed by Young, provide smooth inlet and outlet flow with a minimum impact on headers and are removable for ease in cleaning. Tubes are secured into the headers to prevent leakage from vibration and temperature changes.

Oil Control Ring

A new oil control piston ring with a very low rate of tension loss and a new high strength alloy iron for piston rings are two recent developments by Muskegon Piston Ring Company.

The new *Flexline* oil control rings are one-piece steel rings of the circumferentially compressible type. Features of the new ring include complete side sealing of the openings between the segments forming the ring lands, together with unusually high resistance to carbon plugging. Tension loss resulting from wear occurs very slowly. Another outstanding feature of the ring is its ability to conform to all cylinder contours.



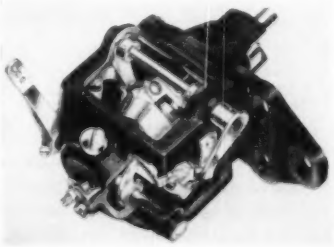
Spartalloy ECH-101, originally developed for aircraft piston rings, is a new type high strength alloy iron now available for other piston ring applications where its high strength and thermal stability enable it to withstand unusually severe operating abuse. The alloy is of the controlled structure type, electrically melted, centrifugally cast, and specially heat treated to provide top physical properties. Its tensile strength is 88,000 psi minimum. Its metallographic structure is characterized by a matrix of spheroidized, tempered martensite, graphite being present in temper carbon form.

Centrifugal Governor

Hoff Products Company has broadened its activities in the governor field with the introduction of the new Hoff Mechanical Governor for industrial engines of all types.

This new governor has been designed to provide accurate control, yet cover a broad operating range, with exceedingly close regulation regardless of load conditions. The spring system has a wide adjustment latitude, and its design eliminates the necessity of using exact pulley sizes to insure accurate performance.

Made primarily for belt drive, the governor can be adapted for gear drive and may be supplied with or without a speed control lever operated from the dash. Ball bearing throttle boxes are supplied where necessary.



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1 to 30,000 RPM

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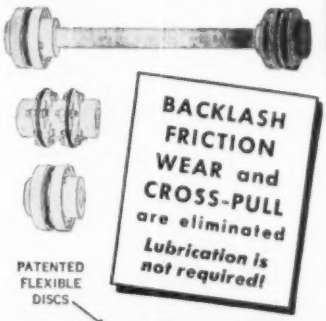

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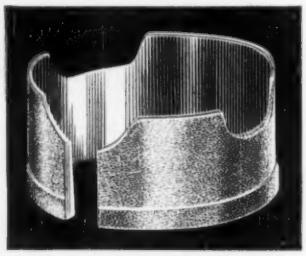
WARREN, PENNSYLVANIA

Ball, roller and needle bearings, used throughout at all load and friction points, provide smooth free-running operation, insure sensitive control and provide long life. All thrust surfaces are hardened and ground, and a light weight throttle actuating lever gives freedom from surging.

Ring Inserter

A new Ring Inserter has just been announced by Herbrand Tools Co. Three finger openings are provided so each ring may be guided into the groove in the piston while pushing the piston into the cylinder. A small slotted section in the wall of the tool permits



expansion for installation of pistons and rings up to 0.060 oversize. It is specially designed to handle the new *U-Flex* as well as all other types of rings. It is claimed that this tool will save up to 50 per cent of the time it takes to compress and insert rings and pistons.

Filter Cartridge Refills

Addition of the new, low cost "S" Type cartridge to a recently developed series of oil purification cartridge refills now enables Honan-Crane Corporation to offer a complete, economical selection of filtering mediums for the correct handling of every purification problem.

Longer refill life, thorough oil purification and trouble free performance with cartridges are claimed to be effected through the use of Honan-Crane's high grade purifying media, "*Crainite*" (specially processed fullers earth) and "*Palconia*" (carefully blended cellulose fiber). Cranite and Palconia are available either in bulb or in three types of interchangeable cartridge refills, Types "MC", "MF" or the new "S" cartridge. Easy-to-handle refills remove either solids or product of oxidation or both.

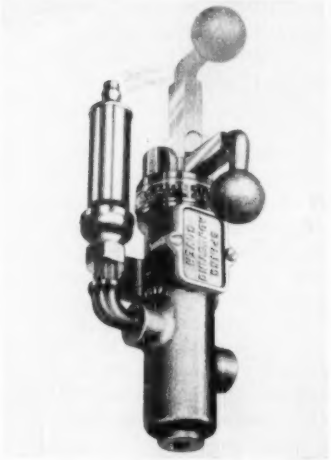
Low Pressure Alarm

A new low pressure alarm designed to give positive warning when lube oil pressure fails has been developed, and is now being distributed, by Mid-Continent Supply Company.

The new whistle type alarm is made from sturdy cast bronze and stainless steel and will fit any make or type of engine. It gives a shrill and positive warning when the lubricating oil pressure fails for any reason.

Operation of the alarm is wholly automatic and the installation is simple. It is easily attached to the engine block or any other convenient location and is put into operation by attaching the air line and the lube oil pressure line to the points marked on the unit.

If the lube oil pressure fails, the piston in the cylinder is retarded enough to permit the air to pass through and operate the whistle which will sound until the lever is flipped into



the vertical position. This gives the operator a simple, automatic and positive warning.

Battery Vent Cap

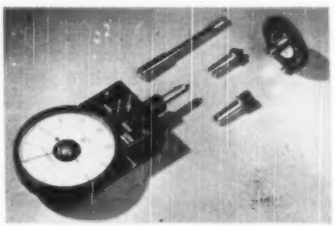
Gould-National Batteries announces a new loss-proof Hinged Vent Cap, designed particularly for railroad air conditioning and car lighting batteries but also applicable to storage batteries used for other purposes. The new vent cap is hinged in place and cannot be shaken loose or lost, the firm said. If left open the cap falls shut with normal train motion. Thus, electrolyte cannot spill from the battery nor can extraneous materials fall into it.

The base of the cap fits into the hole provided for older-type vent caps. The cap itself is hinged to this base and is easily opened for the addition of water. A neoprene baffle, an integral part of the cap, closes into the opening in the base to prevent electrolyte from spilling. Two tiny pinholes in the baffle permit gas to rise above the baffle, condense, and flow back into the cell.

Hand Tachometer

A dual range hand tachometer with ranges from 0/1000 and 0/5000 rpm. has been introduced by Equipoise Controls, Inc. Called the Smith Model A.T.H. 10 dual range Hand Tachometer, the instrument features very low torque, 0.40 oz.-in. on lowest range.

The two scales are printed in different colors and the firm says that a revolving Alnico permanent magnet in-



side the drag cup assures extreme sensitivity and accuracy over the entire scale range. Accuracy of 0.5 of 1 per cent is guaranteed. A knurled knob for range selection is provided and a push button is located on the side of the instrument for releasing and/or holding the pointer at the machine speed indication.

New Worthington Compressor

An improved 105 cu. ft. portable air compressor has been announced by Worthington Pump and Machinery Corporation. The new compressor is lighter, lower and more maneuverable. It is built around the standard Worthington Blue Brute compressor and is powered by either diesel or gasoline engine.

New features and advantages claimed by the manufacturer include: a new zero pressure retractable third wheel; new underslung spring mounted undercarriage with heavy duty commercial 15 in. trailer tires; a simple, retractable support leg; a new style unit core radiator with pressure cap to prevent boiling and better operation of engine at higher temperatures and altitudes; and relocation of instrument panel and battery box to give unrestricted full length tool boxes.

The redesigned compressor is 10 in. shorter, 4 in. lower and weighs 300 lbs. less than previous models.

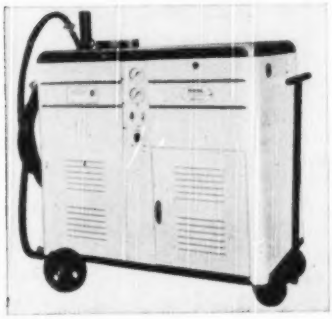
Steam Cleaner

A new and improved heavy duty type vapor steam cleaning machine for general industrial, automotive, railroad, aviation and other uses has just been announced by the General Equipment Division, Sterod Manufacturing Company.

The manufacturer states that the "General" Vapor Steam Cleaner has been carefully engineered to provide peak efficiency of performance at minimum expense.

A fully automatic, safety protected system enables one-man operation while at the same time accelerating the cleaning process. At the snap of a switch a spark is generated which ignites the burner and puts the machine in action. From this point on, fully automatic controls maintain the operation at its peak, thus eliminating time consuming adjustments.

The "General" is ready for action almost instantly, the maker states—a full operating pressure being generated



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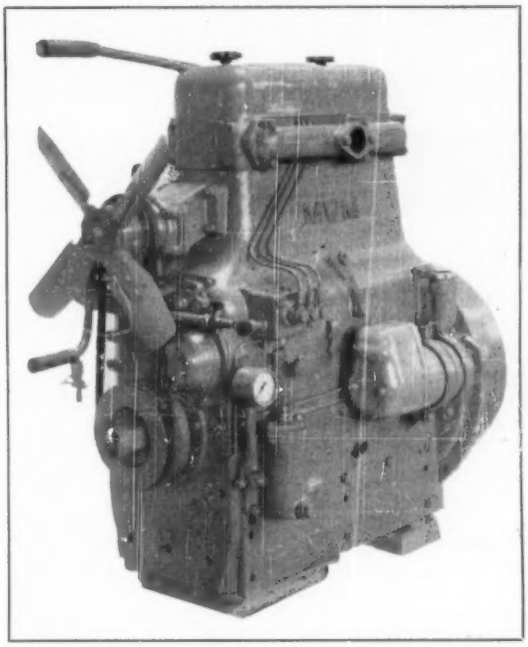

Illustrated: Model KDW 415D
Portable 3 Cyl. 18-36 H.P.—750-1500 RPM

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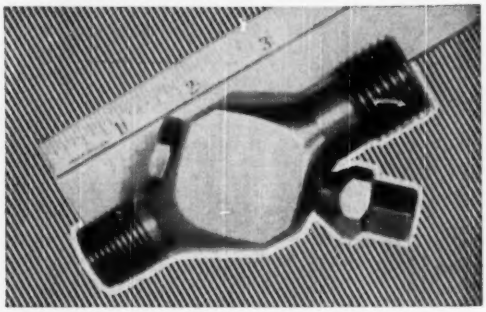

KIENE VALVES are designed to give good service under most severe conditions. WILL NOT BLOW OPEN, as valve opens against pressure. The KIENE VALVE HAS EFFECTIVE GAS SEAL when opened or closed, without use of packing or glands.

The KIENE VALVE is SMALL AND RUGGED, 4¼" in length and requiring only 3¼" circle of space for attachment. Has been operated at pressures up to 10,000 psi.

ALL KIENE VALVES have standard indicator plug and wing nut connection. Regularly furnished with male ½" NPT engine connection. Other threads furnished on order. Special adaptions for most Diesel locomotive engines.

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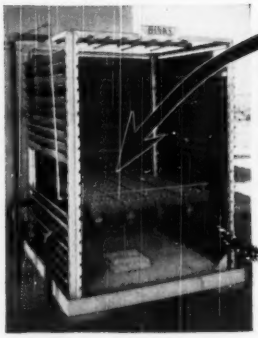

Binks closed-type
DIESEL COOLING SYSTEMS

A Binks natural draft cooling tower with louvers removed to show Binks closed-type evaporative heat exchange coils.

Increased and more uniform heat transfer

Binks Type "D" evaporative heat exchange coils assure Diesel operators uniform...economical engine performance. Two-way cooling by "evaporation" and "convection" plus higher velocity of hot jacket water inside coils gives increased heat transfer. Scale formation in engine jacket is prevented since jacket water never mixes with raw cooling water. Breakdowns are reduced; insurance cut.

Send for Bulletin 41. Obtain full information—drawings, tables—on heat exchange coils adaptable to a variety of operating conditions.

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within 90 seconds. There are no delays necessary—no waiting to check proper burner adjustment, no settings to watch. The entire system is automatically protected from excessive pressures at three independent points. A mechanical outside safety valve is provided as a check on the electrical limit switch and by-pass valve. Heating coils are protected by a special control which stops the entire unit should the water supply fail or become inadequate, thus obviating any possibility of burning out the heating coils. And finally the entire electrical system is protected by a conveniently located over-load switch.

Impact Tool

With a twist in the desired direction and a few raps with a hammer, screws, bolts or nuts can be tightened or loosened easily and quickly with a new, simple hand tool named the *Impakdriver*. The tool is constructed on a cam principle that translates the impact from a hammer's blow into a high torque. It is a product of H. K. Porter, Inc.

Said to be particularly useful for starting stubborn nuts, bolts or screws that are rusted or frozen on, the tool also provides a simple answer for working in hard-to-get-at places. For mechanics, machinists, repair men, maintenance men, etc.,—in fact, for anyone who uses wrench or screwdriver the tool may solve many problems and save a tremendous amount of time.

The *Impakdriver* is sold by itself or in sets with different combinations of bits and sockets for various sizes and types of screws, bolts and nuts. These attachments have been specially engineered to give best results and are constructed of alloy steel.

Gas Engine Mufflers

With the extension of natural gas to many parts of the country, the Burgess-Manning Company announces development of noise abating and safety equipment especially designed for engines using natural gas as fuel. The new series of Snubbers is said to decrease noise from exhausts of internal combustion engines and can also be used to reduce hazards of fire and explosion, it was reported.

The heavy duty, side inlet spark extinguisher Snubber "combines exhaust quieting with freedom from the danger of fire or explosion of gases within the Snubber," according to the company announcement.

This series, it was stated, can be used with or without "fog jet" which sprays a cooling mist of water vapor on the exhaust entering the snubber. Flame from the engine is cooled and extinguished while gas in the Snubber is made non-inflammable by the water fog, it was explained.

Exhaust quieting is effected by coaxial snubbing tubes which "disperse the high pressure slugs of the exhaust stream in the first chamber which is followed by a second standard snubbing chamber."

Internal Grinding Attachment

A new constant speed precision grinder has been developed by South Bend Lathe Works to meet the need for an internal grinding attachment having sufficient power to maintain a more

constant wheel speed under varying loads and to prevent stalling under comparatively heavy cuts.

The grinder is powered by a standard type, constant speed, continuous duty 1/6-hp., 3450-rpm., A.C. motor. The motor is compounded belted, through an intermediate shaft, to obtain a quill spindle speed of 30,000 rpm. Tests have shown that less than 1000 rpm. drop in spindle speed occurs when taking cuts as heavy as 0.003 in. on a side in hardened steel. Power loss is negligible.

The grinding wheel and intermediate shaft spindles run on high precision, high speed ball bearings which require no adjustment. Lubrication is supplied from built-in oil wells. Oil is effectively sealed in the spindle units, and dust sealed out in such a way that the bearings will retain their precision indefinitely. The compound belting and the two pulleys are enclosed by a one-piece guard. Four arbors are supplied, the longest permitting a hole 3/8 in. deep to be ground when using a 1-in. wheel.

Tool Attachment

A new attachment to convert any 1/4 in. drill into an automatic nut running and screwdriving tool has been introduced by the Herbrand Division, Bingham-Herbrand Corp. Called the *Drill-O-Driver*, it employs automatic friction drive to permit an operator to regulate speed and force. It is said to increase the efficiency and utility of any electric or pneumatic drill as a

driver of oil pan bolts, head nuts, machine screws, cap screws, sheet metal screws and wood screws.

The attachment fastens into a drill chuck just like an ordinary bit. The drill motor can be kept running as the driver is disengaged until pressure is

The latest in Diesel Locomotives

is protected by NUGENT FILTERS

The newest thing to hit the rails in diesel locomotives is Fairbanks, Morse's new 4800 H.P. two unit passenger locomotive. This locomotive is the prototype of Fairbanks, Morse's "Consolidation Line" which will be offered in horsepower ratings from 1600 H.P. to at least 9600 H.P. in single locomotives. Outstanding features are high horsepower per foot of length and increased weight on drivers despite a reduction in over all weight.

In a locomotive of this type when so much depends on efficient day-in and day-out performance, it is natural that Nugent lube oil filters were selected to help protect the vital working parts of the 2400 H.P. engines.

Nugent pressure type filters are your best assurance of clean oil for all types of diesel power. By actual test they get out 99.8% of the dirt. Size for size they offer larger filtering area, and uniform dirt loading provides maximum efficiency and maximum life. Recharges are the inexpensive "Throway" replaceable type.

To get the long, dependable life your diesels were built to give, equip them with Nugent Filters. This is an investment that will come back to you many times over. Available for diesel engines from 1 to 384,000 H.P. in single containers.

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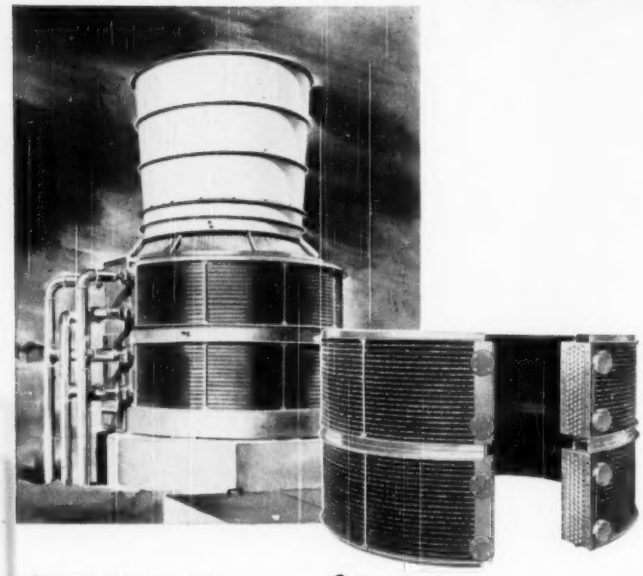
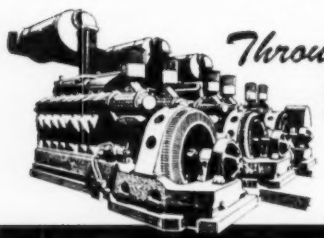


Pictured above is the new Type "E" QUINT-AIR *Air Cooled Heat Exchanger*, designed, engineered and manufactured by J. F. Pritchard & Co.'s Equipment Division. Curved Aerofin sections *(see illustration at right)* enable this unit to take maximum advantage of winds from any direction. Especially suited for engine and compressor jacket water cooling.

...Always Specify AEROFIN

Regardless of the heat-exchange application — or the operating conditions which prevail . . . regardless of the type of atmosphere or liquid, Aerofin will supply the design and materials best suited to the job.

Aerofin's unequalled experience, research and manufacturing facilities in the heat-exchange field are your assurance of greatest efficiency and longest service life.



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applied. The drive automatically cuts out when the bolt or screw is driven home.

The new attachment offers speed and force under precise control of the operator to save energy and time at fastening operations. It operates with equal facility in reverse.

Tachometer Improvements

Two new speed indicating and recording instruments have been introduced by the O. Zernikow Co. A hand tachometer and hand tachograph have been placed on the market to indicate and record speeds.

The hand tachometer has been evolved from the previous model manufactured by the firm. It includes a 3 in. dial, single spindle, quintuple selective range and a rotating gear shift. The instrument is made in three different range combinations for speeds from 30 to 48,000 rpm.

The tachograph combines a special adaption of the tachometer mentioned above with a precision recording mechanism. The instrument is designed to take the place of stationary equipment in many cases.

The tachograph draws charts of speeds on a traveling paper strip, with time marked horizontally and speed vertically. It records rpm., fpm., speed fluctuations, accelerations, decelerations and belt slippage with an accuracy of 0.5 per cent.

New Literature

Centrifugal Pump Guide

Economical pumping units for every industry are catalogued in a new 16-page "Handy Guide to Selection of Centrifugal Pumps" released by Allis-Chalmers Manufacturing Company.

A wide variety of units are indexed in this bulletin including close-coupled, pedestal, double suction single stage, multi-stage, self-priming, fractional horsepower, coolant and circulating, fire, process, solids handling, marine, rubber-lined, paper pulp, sewage, axial and mixed flow pumps.

Head capacity charts and tables for various types of pumps are given along with data on sizes, capacities and construction features.

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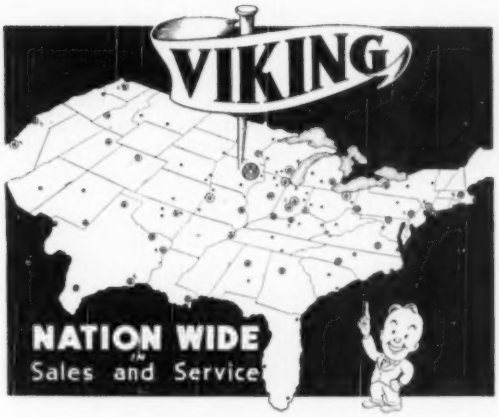

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See Our CATALOG IN SWEETS

Regulator Folder

A new 4-page folder is available from Spence Engineering Company, Inc., which gives useful information on temperature regulators, pressure regulators, and desuperheaters.

A complete explanation of the principles of pilot-operated regulating valves is given in this folder in addition to data and illustrations of 27 Spence pilots.

Grease Folder

Master Lubricants Co. has published a folder covering their full line of *Lubriko* Greases for anti-friction bearings. The folder gives use and application data for 25 different *Lubriko* densities ranging from liquid greases to heavy cup lubricants. Also given are facts on lubrication maintenance and the selection of a lubricant. This is of particular interest to maintenance men and mechanical engineers.

Alnor Bulletin

A new bulletin which describes the complete line of Alnor Dew Pointers has recently been released by the Illinois Testing Laboratories, Inc. The six-page folder gives a complete description of the instrument and also includes a description of the Alnor Dew Point Calculator which is used to convert pressure ratio readings to dew point temperatures. Advantages of the dewpointer, such as accuracy, portability, simplicity of operation, etc., are listed in the bulletin.

Metallizing Bulletin

In a new four-page bulletin the Metallizing Engineering Co., Inc., describes and illustrates several applications of a process for protecting metals against heat oxidation. Life of these parts has been increased from 200 to 300 per cent.

The experience of Permanent Metals Inc. is cited in the bulletin. The normal life of untreated steel retort bottles used in magnesium production by the firm approximated 15 heats. When given this special metallizing treatment, however, these retorts reached 60 heats or more before retouching became necessary according to the firm. The life of these bottles can be lengthened indefinitely by retouching with the special process whenever signs of attack appear. This user has also increased the life of one-ton foundry crucibles, which are subjected to temperatures varying from 1700 to 1900 deg., from approximately 500 hours to as high as 2000 hours.

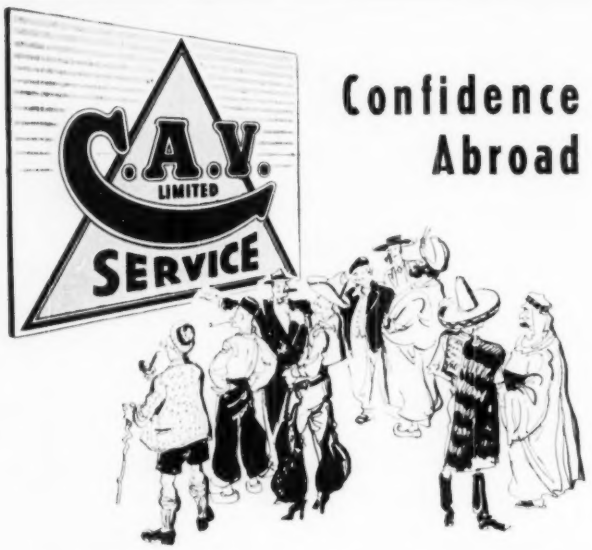
Pump Bulletin

A bulletin which gives a complete description, cross-section drawing, rating tables and dimension print of the new DeLaval Type GS pump has been made available by the De Laval Steam Turbine Company. The principal feature of the new pump is that it is designed to fit the idea of a service and exchange plan. All parts of the GS pump except the bare pump casing are contained in one easily replaceable rotor assembly. With this arrangement, when maintenance becomes necessary, the mechanic simply removes the top cover and end plate studs, removes the old rotor assembly and drops a new one in place. The old one is then returned for credit on serviceable parts.

"Cat" Publication

"Service Reporter" is the title of a new publication being released by Caterpillar Tractor Co. The new booklet is written informally in "easy to understand" language and contains many helpful hints and much basic information on how to keep "Caterpillar" equipment in good working condition.

"Service Reporter" is compiled and edited by Vic Woodling, supervisor of dealer service publications and the "Caterpillar" service staff. For the present it will be issued four times a year—October, January, April, and July. Each issue will contain subjects applicable to every owner—fleet or individual—and will not be confined to one class of equipment. Timely topics will be a feature in the new publication. For example, the first issue has on the cover "Pre-vision for Winter" with copy explaining service requirements of "Caterpillar" equipment in wintertime.



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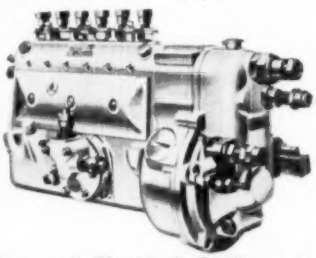

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Book Review

Procedure Handbook of Arc Welding Design and Practice. 9th Ed., The Lincoln Electric Co., 1200 pp. $2.00.

In a new 9th Edition, the "Procedure Handbook of Arc Welding Design and Practice", published by The Lincoln Electric Company of Cleveland, Ohio, has been completely reorganized and re-edited to bring all information up-to-date and include recent important welding improvements. New design data has been included to make the Handbook more helpful to designers of welded machines and structures. Latest procedures are given for welding all metals and alloys commonly welded with manual open arc and hidden arc welding as well as automatic and semi-automatic hidden arc welding.

A completely new chapter on weldability has been written to present a comprehensive survey of this important subject. The latest information gathered from research projects and recent studies gives the facts which have changed welding procedures on many types of metals in the last few years.

The section on structural design has been enlarged and revised to include more information on welded rigid framing. Design techniques developed by leading consulting engineers for newly built structures are included.

The machine design information in the Handbook has also been enlarged to include more information on the welded design of machine tools. This is in addition to the design data revised for other machinery of all classifications.

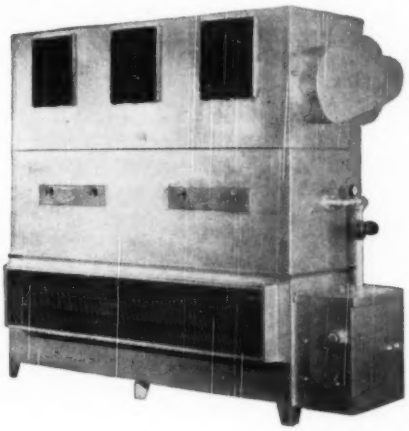
A completely new chapter has been added to the Handbook on welded design data. This chapter presents the fundamentals of welded design for both machinery and structures. It gives fundamentals, such as stress allowables, which can be applied to particular design problems. This chapter gives a designer the necessary tools for approaching any problem he may have in designing for welding.

The new 9th Edition contains over 1200 pages with more than 1300 illustrations.

Write for this bulletin

—ON EFFICIENT DIESEL COOLING

"Buffalo" Evaporative Coolers operate by evaporation of spray on spiral fin coils. This means efficient, positive cooling, with savings on water and fan and pump power. It also means closed-system cooling of jacket water, which keeps impurities out. Many other advantages over cooling towers and spray ponds, such as simpler servicing, simpler installation indoors or out. WRITE FOR BULLETIN 3666.



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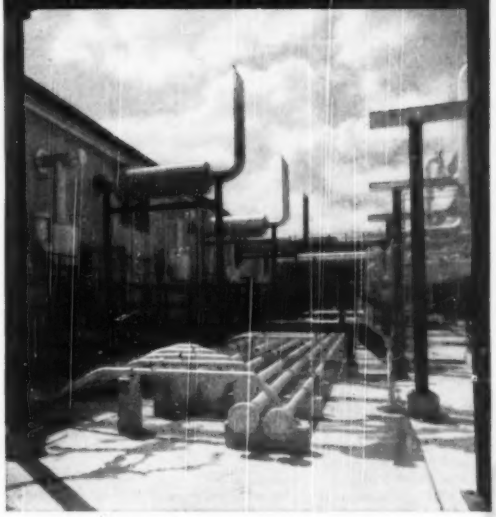
EVAPORATIVE COOLERS AND AXIAL FLOW FANS FOR COOLING MOBILE AND STATIONARY DIESELS

MAXIM SILENCERS



IN VENEZUELA

The photograph above shows three of the eight Maxim Silencers installed at the Creole Petroleum Corp., Mulata Crude Stabilization and Pressure Maintenance Plant in Venezuela. This compressor building houses eight 83-KVG Ingersoll-Rand Compressors with provision for increasing if necessary.

This is just another example of the broad acceptance of the Maxim name and Maxim products when silencing is required. Maxim's longer experience in the silencing field, backed by Maxim's progressive research and engineering staff, brings to each silencing problem the kind of specialized attention that means "more for your money." It's just common sense to "be sure it's a Maxim."

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THE MAXIM SILENCER COMPANY

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MAXIM

Field Notes

Superior Dual-Fuel Engine for Wolverine Co-Op

Headed for Burnips, Michigan, where it will take its place beside three other Superior engines in a power plant there, is this 8-cyl. supercharged dual-fuel engine.

The plant is located between Grand Rapids and L· e Michigan and currently comprises three Model 60 Superior engines, two of which are dual-fuel units. Operating records of the Wolverine Electric Co-operative, owner of the engines, have indicated very favorable results and the new engine shown above was ordered to supplement the existing power facilities.

Diesel Rail Car Sale

The Consolidated Railroads of Cuba have ordered 12 self-propelled Diesel Rail Cars from The Budd Company, according to an announcement by Edward G. Budd, Jr., president. This is the second substantial foreign order for the new RDC's, Mr. Budd stated. The Cuban order consists of seven RDC-1's, which are 90-passenger coaches; and five RDC-2's, which seat 71 passengers and have 17-ft. baggage sections. Delieveries are expected to commence early in January, 1951.

The RDC's, which can be operated as single units, or in multiples as trains, will be used on subsidiaries of the Consolidated Railroads of Cuba—The Cuba Railroad, the Cuba Northern, and the Guantanamo and Western, according to Gustavo Pellon, president of the Railroad.

Oakite Meetings

How recent developments in the field of cleaning and allied procedures are helping industry meet the demands of increased production was the central theme of a series of technical-sales meetings held in New York, Cleveland, and Hollywood, California, during the month of November by Oakite Products, Inc.

As in former years, the meetings were in the nature of a general sales and technical review, embodying round-table discussions on new materials and servicing methods designed to save time and work on a wide range of industrial cleaning and associated tasks.

The first of these conferences, held at the Hotel Statler, New York City, November 2-4, was attended by field service representatives of the Company's New York, New England, Southern and Canadian sales divisions. A feature of these meetings were special reports presented by Oakite research chemists, service engineers and technicians on latest trends in cleaning and related practices for nearly every branch of industry. Also discussed were new materials to be made available by the Company during the coming year.

Similar conferences held at the Hotel Statler, Cleveland, November 9-11, and the Roosevelt Hotel, Hollywood, November 16-18, were attended by Oakite technical service representatives from the Chicago, Cleveland, Detroit, Milwaukee and Philadelphia divisions, and the Pacific Coast, Midwestern and Southwestern sales territories respectively.

Henry Ford Memorial Award

The Society of Automotive Engineers (Detroit Section) has announced a new award for the encouragement of younger engineers. It is called the Henry Ford Memorial Award in honor of the late automobile manufacturer, who was always unremitting in his efforts to encourage the young engineer. The award was established by the Detroit Section, but any S.A.E. member under 33 years of age is eligible to compete.

Competition is by means of original papers which have been presented to, or are suitable for presentation to an S.A.E. meeting. Content of competing papers is limited to subjects related to automotive ground vehicles and must describe engineering work or investigation with which the author has been directly associated. The award consists of a suitable certificate of merit and a cash prize of $200.

A brochure, giving detailed information, has been prepared by the Society. Members desiring to compete may obtain copies through their local S.A.E. Section or by writing directly to the Detroit Section, Society of Automotive Engineers, 100 Farnsworth, Detroit 2, Michigan.

Double Seal Contest

Two hundred and ninety-eight new customers are on the books of the Double Seal Ring Company as the result of a sales contest, results of which were announced recently by Buryl Wilson, sales manager. The "New Customer Round-up" at Double Seal spurred all of its 54 field representatives of the company to obtain new accounts. Emphasis was placed on obtaining new customers after a study revealed that 93.7 per cent of Double Seal's business was coming from old customers.

More customers, more repeat business was the obvious theme which Wilson hammered at his salesmen during the contest. A regular record of adding three new customers per month for a year would double the average Double Seal salesman's income, he emphasized.

Jim Ritchie of Tulsa, Okla., who rounded up 23 new customers to lead the contest, said he "particularly liked the contest because the work I put into it will continue to bring results long after the contest is over."

Finishing close behind Ritchie in new accounts obtained were Frank Welu of Houston, 19; Claude Clingman of New Orleans, 18; Les Gawlocki of Boston and Harry Morrison of San Francisco, 17; and Del Clark of Little Rock, 15.

Aluminum Production

"Production of primary aluminum in the United States during the third quarter of 1950 reached the highest level since the second quarter of 1944," Donald M. White, secretary of The Aluminum Association, said recently, "but even with this high rate of production the industry is unable to supply all the metal desired by civilian users after meeting our mounting military needs." The 371,945,743-lb. total for the third quarter topped the year's second-quarter production of 360,707,827 lb. by about three per cent.

Primary production during September was 118,398,418 lb., more than five per cent below the 126,011,903 lb. for August, Mr. White reported. This was because September is a shorter month and because the strike which began in August in one of the reduction plants continued throughout September, he explained.

DEMA Symposium

Approximately 65 New England college professors and representatives of the diesel engine industry in New England attended an educational symposium on Diesel Engine Problems held at the Massachusetts Institute of Technology on October 21st, under the joint auspices of that institution and the Diesel Engine Manufacturers Association.

Highlights of the program included papers on diesel engine research at M.I.T. by Professors C. F. Taylor and A. R. Rogowski of the Sloan Automotive Laboratory staff, and a symposium on air and oil filtration by representatives of three New England filter manufacturers, Commercial Filters of Boston, Fram Corporation of Provi-

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FOR CORROSION CONTROL

LOCOMOTIVE DIESELS—Add 6 lbs. of Sodium Chromate to systems having a capacity of about 250 gal., and maintain concentration at about 2500 ppm.

MARINE DIESELS—Start with about 2000 ppm of Sodium Chromate in the engine-jacket system, and maintain this concentration. Submarines and some other naval vessels provide an additional factor of safety by employing 5,000 ppm.

STATIONARY DIESELS—Start large installations with closed engine-jacket systems by adding 1000 ppm of Sodium Chromate; later maintain about 400 ppm. For smaller installations, employ higher concentrations. For open systems, start with 500 to 1000 ppm of Sodium Chromate and lower the concentration over a period of 1 to 3 months to the lowest maintained concentration at which protection is satisfactory, usually about 200 to 500 ppm. For large open systems employing cooling towers, use Sodium Bichromate and adjust to pH 7-9.

Write for complete information about the applications in which you are interested.

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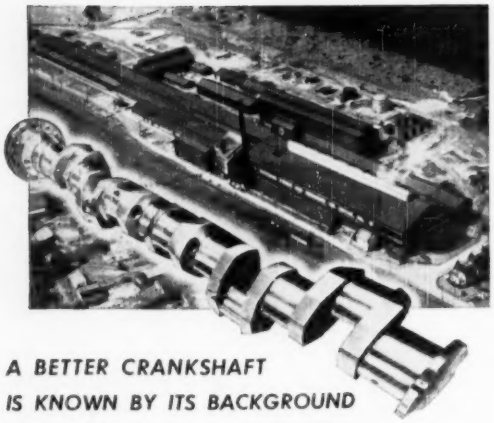

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Many of America's most famous Diesel Engines are built with National Forge crankshafts because . . .

We make our own basic electric steel—our forgesmiths are long-time experts in crankshaft forging—the heat treatment is handled in deep vertical furnaces—and our special machine tool equipment, manned by skilled craftsmen, assures adherence to close tolerance specifications.

Let us tell you why you will be better satisfied with your crankshafts when you have them National-forged.

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STEEL MAKERS • FORGESMITHS
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AC Generators: 6¼ to 1000 KVA
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Write for information. Our Engineers will be glad to review your requirements.

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dence and Cuno Engineering of Meriden, Connecticut.

Inspection of the Gas-Turbine Laboratory, the Sloan Automotive Laboratories and the new Hydrodynamics Laboratory, including the Ship Model Towing Tank, were included in the program. At the Sloan Laboratories special apparatus for taking motion pictures of combustion flames at the rate of 3000 frames per second was demonstrated, while at the towing tank apparatus for measuring towing forces as small as one thousandth of a pound was explained to the visitors.

Lister-Blackstone Showcase

Show Window premises in the Grand Central Terminal District of New York City have been acquired by Lister-Blackstone, Inc., manufacturers of diesel engines.

The new premises, located at 49 Vanderbilt Avenue, will supplement the Company's Executive Offices at 420 Lexington Avenue, New York, and will be used for displaying latest models of the Company's line of diesel engines, generators, and marine auxiliary units.

In addition, maintenance and spare parts service for the Greater New York Area will be handled out of the new premises.

Inco Display

A wide variety of corrosion, wear and heat-resistant equipment for power and associated industries was shown in International Nickel's Booths No. 8 and 9 at the National Exposition of Power and Mechanical Engineering at Grand Central Palace, November 27th to December 2nd.

On display were such standard items as valve trim, pump shafts, and impellers. Among these specialties will be a furnace fuel oil atomizer made of Monel by the precision investment casting method. Use of this method of production has reduced the number of parts from six to three.

Lanova Patent Validity Upheld

Sometime ago the United States Government brought suit against the Lanova Corporation, seeking to cancel certain of their patents. The Government has concluded to dismiss that action "with prejudice" and an order has been entered accordingly. This means that the action has been terminated on the merits and the validity of said patents is no longer in question.

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SAVES FUEL & LUBE OIL
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PIONEERS IN DIESEL TESTING EQUIPMENT

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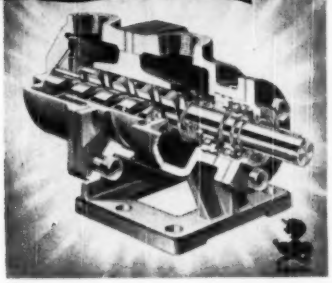
PUT THIS *New Low Cost* IMO ON YOUR OIL LINES!



Now you can have all the advantages of the IMO: high speed operation – quietness – freedom from vibration – simplicity – reliability – at less cost than ever before.

Look at the cross-section and you will see why no other pump is quite so well suited for oil handling service.

The axial flow design permits oil to be pumped close to the rotating axis of the rotors. This means low liquid velocity and quiet operation at high speeds.

Large inlet areas provide smooth entrance of liquid into the pump and permit the handling of high viscosities at high suction lifts.

The A313A IMO has no stuffing boxes to leak or require packing, and best of all, it can be mounted in any position and be directly connected for operation at motor speeds.

For your next oil handling job, be sure of the best . . . specify the new low cost A313A IMO pump. Write for Bulletin 1-161R-DR.

IMO-DE LAVAL PRODUCTS DIVISION
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It pays to specify . . .
THE LANOVA COMBUSTION SYSTEM*

The controlled rotary turbulence set up by the Lanova System gives a Diesel these outstanding advantages

- High combustion efficiencies
- Smooth, powerful thrust of working pressures on the pistons
- Elimination of jarring pressure knocks during combustion
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Be combustion-wise and economize. Look for the familiar Lanova energy cell in your next Diesel.

LANOVA CORPORATION
38-17 30th St., Long Island City 1, N. Y.

THE HEART OF THE DIESEL

** Available only in Diesels manufactured by Lanova licensees. Send for the names of these leading engine builders.*

LANOVA *makes Diesels purr*

FOR YOUR BIG COOLING* JOBS

SPECIFY THE VAD

VERTICAL AIR DISCHARGE

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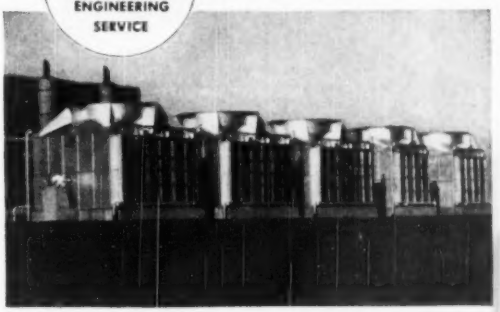
Below: Application of two VAD-10, and three VAD-12 units which cool the jacket water and lube oil cooling water for five huge engines.



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● Versatile "VAD" Units are available to dissipate from 3,000,000 to 15,000,000 Btu per hr per unit under standard conditions. Vertical air discharge prevents loss of efficiency due to cross-winds . . . permits in-line installations. Improved design, fewer piping connections, factory built sub-assemblies, and low-level mounting are but a few of the many features that mean quick, economical, easy erection in the field . . . lower installation and maintenance costs . . . long, efficient service.

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HEATING, COOLING, AND AIR CONDITIONING PRODUCTS FOR HOME AND INDUSTRY.

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Esso-Dema Symposium

A one-day educational symposium for educators teaching courses relating to diesel engines was recently held at the Esso Research Center of the Esso Standard Oil Company at Linden, New Jersey.

One of a series of regional meetings sponsored by the Diesel Engine Manufacturers Association, the program is designed to provide teachers with an opportunity to acquire information and broaden contacts in the field as an aid in instructing their classes.

The program at the Esso Research Center consisted of a welcome by A. J. Blackwood, assistant director of the research division, talks on various aspects of industrial research and diesel engines, and a tour of the laboratories and refinery facilities. Attending the seminar were 30 educators and the Esso research staff.

Snow-Nabstedt Outlet

Appointment of Pacific Marine Supply Company of Seattle, Wash., as its distributor for Washington, Idaho, Montana and Alaska has just been announced by A. T. Nabstedt, Jr., director of marketing and asst. treasurer of the Snow-Nabsted Gear Corp.

A franchise agreement was signed by W. Angus, President of one of the West Coast's largest chandlers, following negotiations between J. Suarez, sales manager for Snow-Nabstedt, and J. I. MacNichol, Pacific Marine Supply's engine sales manager.

The distributor arrangement includes warehousing of Snow-Nabstedt products and parts in Pacific Marine Supply's headquarters at Seattle. The entire line of Snow-Nabstedt hydraulic and manually operated reverse and reduction gears, power take-offs and speed reducers will be distributed thru Pacific's affiliates in Hoquiam, Tacoma, Ballard, Everett, Bellingham, Marine Supply Stores plus travelling representatives in Alaska. Oregon Marine Supply Co., franchised distributors for Snow-Nabstedt equipment complements Pacific Marine Supply's marine sales and service throughout the Pacific Northwest.

Lister-Blackstone Brings You World's Largest

8 H.P.
20 H.P.

AIR-COOLED DIESELS

Products of the plant producing the world's most powerful aerojet engine, the 'Sapphire", these engines are manufactured by the Armstrong-Siddeley company and sold and serviced exclusively by LISTER-BLACKSTONE, Inc.

THOUSANDS IN SUCCESSFUL OPERATION

Compact—pressure-lubricated—low fuel consumption. Suitable for all SAE attachments, standard 12-volt Autolite starting. Portable or stationary. Widely adaptable for generators, hoists, pumps, compressors, agricultural machinery, equipment for contractors, quarry and mining, mechanical handling, marine auxiliary and propulsion.

ATTRACTIVELY LOW PRICED. AVAILABLE FOR DELIVERY.
PLENTIFUL PARTS STOCKS THRU LISTER-BLACKSTONE DISTRIBUTORS EVERYWHERE

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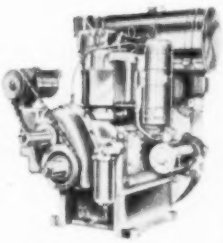

2 cyl. Model AS-2

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Factory, Sales & Service Headquarters

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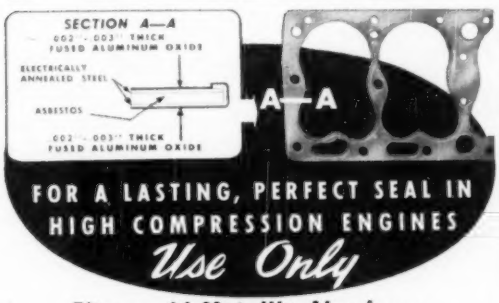
MODEL AS-1 1 cyl. 8 H.P. @ 1200-1500 r.p.m.
MODEL AS-2 2 cyl. 20 HP. @ 1800 r.p.m.



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Grease Retainers — Cork Gaskets

FITZ-Rite* Treated Fiber Gaskets for oil, gasoline and water connections. Complete Sets For Motor Rebuilders. ***S. M. Reg. Pending**

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There's a Fitzgerald Gasket for every Engine

Attention: Maintenance Superintendents and Owners of Diesel-Powered Equipment

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RECONDITIONED UNIT INJECTORS FOR GM 71 AND 567 ENGINES ARE AVAILABLE FROM OUR STOCK ON AN EXCHANGE BASIS.

HANCOCK Service Gives You:

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- The service of a modern injector laboratory completely tooled with the latest grinding, lapping and gaging equipment to handle all necessary work.
- A flat price for injector exchange regardless of condition of the plunger and bushing.
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- Any output of 71 engine injector available — 60 mm, 70 mm, 80 mm and 90 mm.
- An unconditional guarantee of satisfaction.

We will buy used General Motors and Caterpillar injection equipment.

Dealers write for our attractive proposition

DIESEL SERVICE DIVISION

HANCOCK MACHINE COMPANY, INC.

300 WALNUT STREET FINDLAY, OHIO

Mack Sales

Mack Trucks, Inc., and subsidiaries' sales for the first nine months of this year were greater than for the same period of 1949, E. D. Bransome, chairman and president, announces. Sales for the nine-month period ended September 30 totalled $85,098,288 compared with $53,889,305 for the same period last year.

Based on these sales, consolidated net earnings for the first nine months of 1950 totalled $198,948 equal to 13¢ per share of common stock, after provision of $194,923 for Federal and Canadian income taxes. This compares with a net loss of $2,355,093 for the same period of 1949, after provision for a reserve of $900,000 for revaluation of inventories, and after credit for Federal income tax carryback of $1,600,000.

In issuing the report, Mr. Bransome expressed gratification over the company's progress so far this year.

"Changes in manufacturing and personnel have increased our operating efficiency; sales started rising in the early part of the year and are holding steady. If we are not hampered by material shortages or other difficulties, there is every reason to believe that the final quarter should be better than the third."

New Binks Plant

To better serve the rapidly expanding industrial West, the Binks Mfg. Co. has purchased a substantial new plant, located at 4915 Pacific Boulevard, Los Angeles. Occupancy of the new building is scheduled for the end of October.

The plant is designed for light industrial work. It will be operated under the direction of J. E. Roche, manager of the West Coast Division, covering the seven States of California, Oregon, Washington, Arizona, Utah, Nevada, and Idaho.

This office will be the focal point for all branch office work involving the warehousing and selling of standard spray finishing and water cooling equipment and the assembly of air compressors. Spray painting booths and water cooling towers will be assembled here from parts made in Chicago. There will be some sheet metal fabricating. It is expected that manufacturing processes will be expanded in the future.

Corrosion Test Station

Representatives of more than 100 industrial companies and government officials attended the formal opening on November 15 and 16 of the new Harbor Island addition to the Kure Beach corrosion testing project near Wilmington, N. C., according to an announcement by F. L. LaQue. Mr. LaQue is in charge of the corrosion engineering section of The International Nickel Company, Inc., under whose direction the project is operated.

Dr. Paul D. Merica, executive vice president of The International Nickel Company presided at the opening.

With the new laboratory and marine exposure racks which have been added at Harbor Island, the Kure Beach project now has increased facilities for the study of the corrosion resistance over 20,000 specimens of all types of materials in sea water and sea air.

Baldwin-Lima Merger

Marvin W. Smith, president of The Baldwin Locomotive Works, and G. A.

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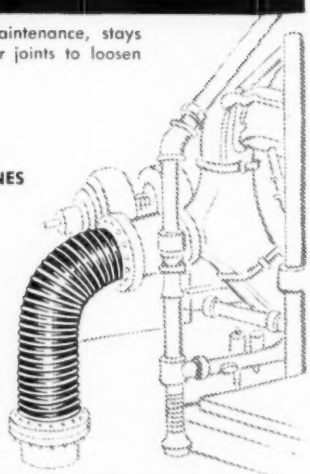

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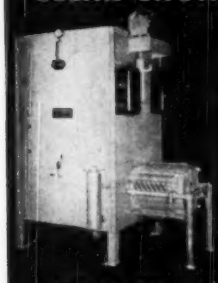

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Rentschler, chairman of the Executive Committee of Lima-Hamilton Corporation, have announced that the Boards of Directors of their respective companies had declared effective the previously announced Agreement and Plan of Reorganization whereby Baldwin will change its name to Baldwin-Lima-Hamilton Corporation and acquire all of the assets of Lima-Hamilton in exchange for stock of Baldwin-Lima-Hamilton. Stockholders' approvals of the action, required to be taken, have previously been obtained.

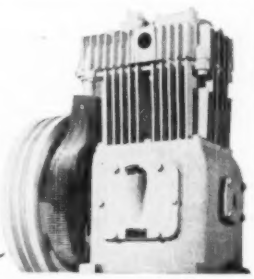
Pursuant to this reorganization plan, Baldwin expects to transfer, prior to November 29th, to the newly organized Baldwin Securities Corporation, its stock in The Midvale Company and in General Steel Castings Corporation and the cash derived by Baldwin from the sale earlier this year of its stock in Flannery Bolt Company. In exchange, Baldwin is to receive all of the shares of Baldwin Securities Corporation stock.

Organizational News

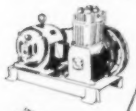
New Worthington Vice Presidents

Austin C. Ross, manager of the Buffalo works of Worthington Pump and Machinery Corporation, has been elected a vice president of that company at a recent meeting of the Board of Directors according to an announcement by H. C. Ramsey, president. Ross will continue to serve as Buffalo works manager, the announcement continued.

MODERN from every angle OUTSIDE



but the inside story of Quincy COMPRESSORS is even better!



Quincy Compressors not only look good as a part of a Diesel installation, they have an established reputation for dependability. Special design features for greater dependability and durability include — Timken bearings — Lynite rods — perfectly balanced crankshaft — copperfinned intercooler — automatic and positive lubrication. Available in a wide variety of sizes ranging from 1 to 90 c.f.m. Depend on a Quincy specialist to help you select the correct type and size compressor to meet your requirements. Write Dept. J-13 for details and prices.

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Representation in Principal Cities

Ross joined Worthington in 1932 as assistant general purchasing agent, became assistant works manager of the Buffalo works in 1935 and works manager in 1940. Prior to joining Worthington, he was associated with Rolls-Royce of America, Inc. in Springfield, Mass.

W. H. Feldmann, vice president in charge of sales, also announced that Harold K. Beck has been appointed commercial vice president, in addition to his present post as manager of the Washington Office of Worthington.

A 25-year veteran of Worthington, Beck received his BS degree in Civil Engineering from Tufts College in 1925 and then took the Worthington training course. His service with the company in several responsible capacities culminated in his present appointment.

Bosch President Also Heads Arma

Donald P. Hess, president of American Bosch Corporation, has been elected president of Arma Corporation, succeeding Herbert C. Guterman, whose resignation was accepted by the Directors.

Arma Corporation is a wholly-owned subsidiary of American Bosch, and employs approximately 2,700 people at its plant in Brooklyn, N. Y. It is engaged primarily in the manufacture of products for the armed services, such as gyroscopic compasses, gunfire control equipment, navigational and plotting instruments, etc.

Mr. Hess will also continue to serve as president of American Bosch Corporation.

American Air Filter's New Pacific Division

Mr. John Hellstrom, vice-president of the American Air Filter Company, Inc., will move to San Francisco shortly to become manager of the newly created Pacific Division. He will directly supervise business activities of both American Air Filter Company and its Herman Nelson Division of Moline, Illinois in the Pacific Territory. The Pacific Division includes the offices and representatives in the States

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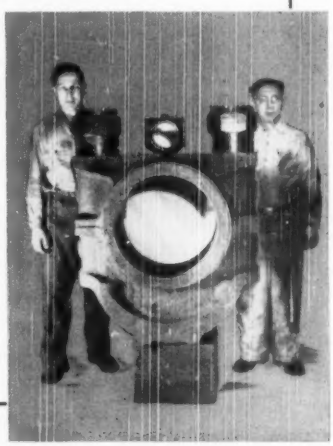
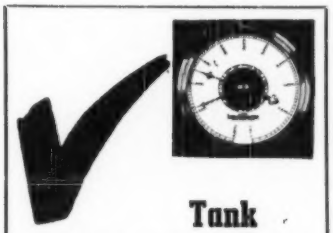


of California, Oregon, Washington, Idaho, Montana, Utah, Arizona, New Mexico and the western part of Texas.

Mr. Hellstrom, one of the pioneers of air filtration and dust control, was president of the Midwest Air Filters, Inc. up to the time it was merged with several other companies to form the American Air Filter Company of which he became president in charge of the Dust and Fume Control Division.

One of his assistants will be Mr. Robert H. Walpole, Jr., who for the last four years has been engineering supervisor of the Company's Dust and Fume Control Division with headquarters in San Carlos, California. Mr. Hellstrom will headquarter in San Francisco with offices in the Standard Oil Building, 225 Bush Street.



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G-E Manager of Service Appointed

Allan L. Davis has been appointed manager of service of the Transportation Divisions of General Electric's Apparatus Department in Schenectady, N. Y., according to an announcement by H. W. Gouldthorpe, manager of the Transportation Divisions.

The position is newly-created and will be one of evaluating and analyzing service requirements for the transportation industry. Pioneer work in service practices will also be undertaken.

Mr. Davis, after attending western colleges, was employed in heavy construction work in the mill, mining, and railroad industries. In 1930, he joined the Los Angeles Street Railway Company, becoming superintendent of car maintenance and was active in the development of the PCC car.

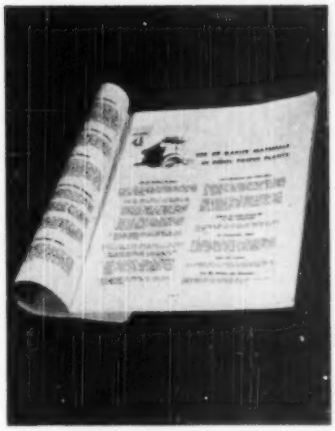
In 1945 he joined G-E as service engineer, Los Angeles office, and was later made transportation engineer. He moved to Schenectady in May, 1947, and was appointed manager of the ALCO-GE Service Engineering Division, a post he has held until his recent appointment.

New Koppers Engineering Manager

Appointment of A. H. Engstrom as acting engineering manager for American Hammered Piston Rings manufactured by the Metal Products Division of Koppers Company, Inc., was announced here today by Walter F. Perkins, vice president and general manager of the Koppers Division.

Mr. Engstrom formerly was assistant to the manager of the American Hammered Piston Ring engineering and research department, Dr. Tracy Jarrett, who resigned because of ill health.

A native of Duluth, Minn., Mr. Engstrom received a Bachelor of Science degree in mechanical engineering from the University of Southern California. Before joining Koppers in February, 1950, he was in charge of diesel production, testing, and service for Continental Motors in Muskegon, Mich. He also was previously associated with Tri-State Railways in Detroit, Mich., as a diesel technician.



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ADVERTISERS' INDEX

A B O E Inc. 3rd Cover
A C Spark Plug Div., General Motors Corp. ***
Aerofin Corp. ***
Aeroquip 84
Air Maze Corp. ***
Allied Metal Hose Co. 94
American Air Filter Co., Inc. 15
American Bosch Corp. 31
American Motors Co. 94
Atlantic Metal Hose Co. ***
Automotive Products, Inc. 90

Bacharach Industrial Instrument Co., Inc. ***
Bendix Aviation Corp., Scintilla Magneto Div. 25
Binks Mfg. Co. 82
Borg-Warner Corp., Rockford Clutch Div. ***
Buchi, Dr. Alfred J. 11
Buffalo Forge Co. 87
Burlington Instrument Co. ***
Burmeister & Wain Corp. ***

Carey Machine Co. ***
C. A. V., Ltd. 86
Centrifugal Foundry Co. ***
Cities Service Oil Co. 61
Cleveland Graphite Bronze Co. ***
Columbia Electric Mfg. Co. 90
Commercial Trades Institute 97
W. J. Connell Co. ***
Cook Mfg. Co., Inc., C. Lee 32
Cooper-Bessemer Corp., The ***
Cuno Engineering Corp. 21

DeLaval Separator Co. ***
DeLaval Steam Turbine Co. 91
Delco Products Div., Gen. Motors Corp. 27
Delco-Remy ***
Detroit Diesel Engine Division, General Motors Corp. 4
Dusquesne Electric & Mfg. Co. ***

Eaton Mfg. Co. 10
Electric Auto-Lite Co., The ***
Electric Storage Battery Co., The 18
Electro-Motive Division, General Motors Corp. 29
Electro Products Laboratories 92
Ellwood City Forge Co. 92
Enterprise Engine & Machinery Co. ***
Erie Bolt & Nut Co. 96

Fairbanks-Morse & Co. ***
Federal-Mogul Corp. ***
Fitzgerald Mfg. Co. 93
Fram Corp. ***
Ernest L. Frankl & Associates 81
Fulton Iron Works ***

General Electric Co. 6, 7
General Motors Corp., A C Spark Plug Div. ***
General Motors Corp., Delco Products Div. 27
General Motors Corp., Detroit Diesel Engine Division 4
General Motors Corp., Electro-Motive Division 29
General Motors Corp., Harrison Radiator Division ***
Sigurd Golten Machine Corp. 96
Gulf Refining Co. 12, 13

Hancock Machine Co., Inc. 93
Harnischfeger Corp. 20
Harrison Radiator Div., General Motors Corp. ***
Hemphill Schools, Inc. 85
Hill Diesel Engine Co. ***
Hilliard Corporation, The 95

Illinois Testing Laboratories, Inc. 17
International Harvester Co. 14

Johnson Bronze Co. ***

Kiene Diesel Accessories, Inc. 82
Koppers Co., Inc., American Hammered Piston Rings Dept. 9

Lanova Corp. 91
Leece-Neville Co. ***
Lempco Products, Inc. 5
Lima-Hamilton Corp. 23
Link-Belt Co. 22
Liquidometer Corp., The 97
Lister-Blackstone, Inc. 93
Lubal, Inc. 90

Madison-Kipp Corporation 24
Manzel Bros. ***
Maxim Silencer Co., The 87
Muskegon Motor Specialties Co. ***
Mutual Chemical Company of America 89

National Forge & Ordnance Co. 90
Nordberg Mfg. Co. ***
Nugent & Co., Wm. W. 83

Oakite Products, Inc. 97

Parker Diesel Engineering Co. ***
Penn Flexible Metallic Tubing Co. ***
Pittsburgh Diesel & Automotive School ***
Powers Regulator Co. 19
J. F. Pritchard & Co. ***
Purolator Products, Inc. ***

Quincy Compressor Co. 95

Rathbun-Jones Engineering Co. ***
John Reiner & Co. ***
Rockford Clutch Div., Borg-Warner Corp. ***
Roper, George D., Corp. ***

Scintilla Magneto Div., Bendix Aviation Corp. 25
Sealed Power Corp. ***
The Sharples Corp. 8
R. H. Sheppard & Co. 95
Sinclair Refining Co. 50, 51
Snap-on Tools Corp. ***
Socony-Vacuum Oil Co., Inc. 34
Standard Oil Co. (California) 30
Standard Oil Co. (Indiana) 4th Cover

Texas Company, The 2nd Cover and 3
Thomas Flexible Coupling Co. 79
Tide Water Associated Oil Co. 26
Tuthill Pump Co. ***

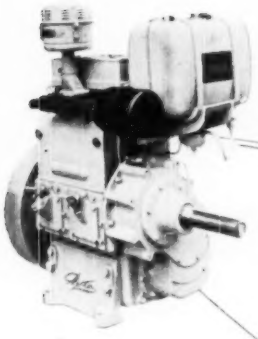
U. S. Hoffman Machinery Corp. ***
Utilities Engineering Institute ***

Van der Horst Corp. ***
Viking Pump Co. 85

Waukesha Motor Co. 77
Wickes Bros. ***
Winslow Engineering Co. 36
Woodward Governor Co. ***
Worthington Pump & Machinery Corp. 16

Young Radiator Co. 91

Zalea Bros. ***



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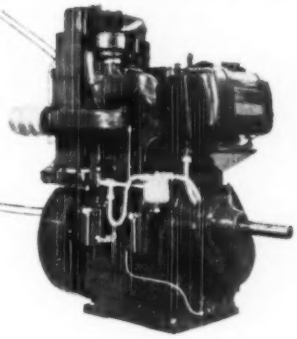

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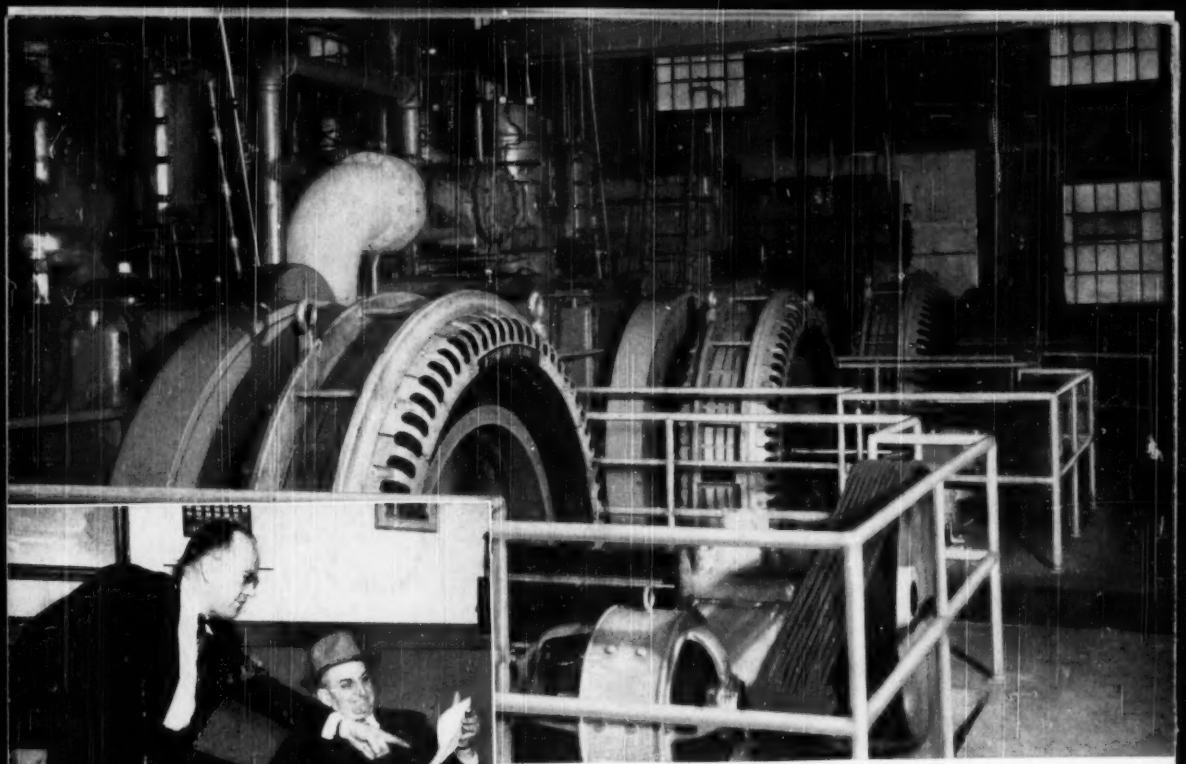

Above—In 1946, STANDARD HD Diesel Oil was tested in a 1400-hp Diesel engine in the Trenton (Mo.) Utilities plant. Today, the success of that trial is reflected by the use of STANDARD HD in the plant's five Diesel engines (one not shown).

Left—W. E. Ralls, plant superintendent, (at the right) and T. N. Okerstrom, Standard Oil Lubrication Engineer, discuss the highly satisfactory report on a recent analysis of STANDARD HD Diesel Oil samples from the plant's engines.

One good job leads to another . . . and another . . . and another!

The experience of W. E. Ralls, Superintendent of the Trenton Municipal Utilities plant at Trenton, Missouri, proves once again that reduction of downtime and maintenance is the Diesel operator's way to judge lubricating oil.

After talking with a Standard Oil lubrication specialist about the advantages of STANDARD HD Diesel Oil, Mr. Ralls put the heavy-duty lubricant to a test in the plant's 1400-hp Diesel engine. STANDARD HD came off with flying colors! The clean and trouble-free operation of this unit sold the new lubricant right into the plant's three 650-hp Diesels. When a new 1600-hp engine was installed in 1948 that, too, was filled with STANDARD HD Diesel Oil.

Today, the success of STANDARD HD on one job after another in this plant is reflected in more reliable Diesel operation and lower maintenance costs.

Let a Standard Oil lubrication specialist help you find how STANDARD HD Diesel Oil can reduce maintenance and overhauls. You can reach him quickly and easily by phoning the nearest local Standard Oil (Indiana) office. Or, if you wish, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

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